NEW SERIES

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 2
JANUARY 15, 1969

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NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign); single copy price is $3.00.

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WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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UNITED STATES DEPARTMENT OF THE INTERIOR
STEWART L. UDALL, Secretary

OFFICE OF WATER RESOURCES RESEARCH
Roland R. Renne, Director

WATER RESOURCES SCIENTIFIC INFORMATION CENTER
Raymond A. Jensen, Manager

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

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Massachusetts Univ, Amherst.
For primary bibliographic entry see Field 02K.
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A MOISTURE-BALANCE PROFILE ON THE SIERRA NEVADA,
Nevada University, Reno, Desert Res. Inst.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-00461

GLOSSARY OF SELECTED HYDROLOGIC TERMS,
Wyoming Univ., Laramie.
Paul A. Rechard, and Richard McQuisten.
Water Resour Res Inst, Univ Wyoming, May 1966. 42 p, 1 tab. OWRR Project A-999-Wyo.

Descriptors: *Hydrology, *Dictionaries, Water resources.

This glossary of terms was prepared so that all persons involved in the project of Water Resource Operations Study would have a common source for the definition of terms frequently used in hydrology.
W69-00666

2B. Precipitation

MEASUREMENT OF PRECIPITATION OVER LAKE MICHIGAN,
Illinois State Water Survey, Urbana.
Stanley A. Changnon, Jr., and Floyd A. Huff.
OWRR Project A-012-Ill, Reprint Ser 65, pp 235-248, 1966. 14 p, 3 fig, 4 tab, 20 ref.

Descriptors: Bibliographies, *Atmospheric precipitation, *Measurement, *Precipitation (Atmospheric), *Rainfall, Radar, Instrumentation, Rain gages, *Lake Michigan.

The increasing need for accurate measurements of precipitation over Lake Michigan led to investigations of radar and climatological methods of measurement. One radar method used dense rain gage networks and 10-cm radars to evaluate the ability of radar to measure accurately the percentage change of warm season rainfall with distance. Long-term mean percentage changes could be used to compile estimates of lake rainfall by comparing the average changes with land precipitation data. This method produced unacceptable errors. Another radar method involved adjusting the radar-indicated rainfall with shoreline rain gage data for each rain, thus minimizing inherent errors resulting from variations of radar reflectivity. By this method, warm season rainfall over certain portions of the lake could be measured with an accuracy of 2% of a long-term operational basis. Difficulties associated with radar measurements of winter season precipitation, plus exorbitant costs of rain gage and radar facilities made this method unfeasible. Mean overlake summer rainfall, estimated using climatological analysis methods appears to be reasonably accurate since the difference between the maximum and minimum possible estimated average amounts over the lake is small.
W69-00406

DETERMINATION OF INTENSITY - DURATION - FREQUENCY - AERIAL COVERAGE OF INTENSE SUMMERTIME STORMS,
Michigan State Univ., East Lansing, Dept. Agr. Eng.
E. H. Kidder.
Terminal Rep, Dep of Agr Eng, Mich State Univ, 1967. 19 p, 2 fig, 3 tab, 2 ref. OWRR Proj A-009-Mich.

Descriptors: *Precipitation (Atmospheric), Intensity, Frequency, *Rainfall, Hydrologic data, *Hydrology, Gages, Precipitation intensity, Analysis, Meteorological data, *Rainfall disposition, *Rainfall intensity.

Precipitation data was collected from a dense network of recording raingages in Ingham County, Michigan, during Aug 1965 - May 1967. Only the storm of July 12, 1966 was significant. Twenty-nine gages recorded amounts equal to or above a 1-yr frequency for 1-hr catches. The catch of 1 gage exceeds a 1 in 25-yr frequency. An analysis of 6-hour amounts showed the catch of 6 gages above a 5-yr frequency. Computer analysis of data did not show a strip pattern of rainfall. It did bring out the repeated higher catch of the 1 gage.
W69-00444

A MOISTURE-BALANCE PROFILE ON THE SIERRA NEVADA,
Nevada University, Reno, Desert Res. Inst.
Charles F. Armstrong, and Charles K. Stidd.
Preprint Series 3, Feb 1967. 20 p, 7 fig, 3 ref. OWRR Proj B-008-Nev.

Descriptors: *Runoff, *Evapotranspiration, *Runoff forecasting, *Precipitation (Atmospheric), Profiles, Orography, Surface runoff, Effective precipitation, Elevation, Moisture availability, Watersheds (Basins), Hydrologic cycle, Topography, Investigations, Forecasting.
Identifiers: Thornwaite method, Sierra Nevada, American River Basin.

Profiles have been developed showing the variation with elevation of: runoff, evapotranspiration, interception, and precipitation. Data are from the American River Basin on the west slope of the Sierra Nevada. Elevations range from 200 to 10,380 ft. Data are adjusted to annual means for a 50-yr period. Results show that precipitation can be estimated as the sum of the three other factors and the resulting precipitation profile shows the general response of precipitation to orography in this region.
W69-00461

PRECIPITATION PROBABILITIES FOR MISSISSIPPI,
Mississippi State Univ., State College.
John C. McWhorter, Kenneth R. Matthes, Jr., and Burrow P. Brooks, Jr.
Water Resour Res Inst, Rept 1966. 51 p, 41 fig, 41 tab, 7 ref. OWRR Project A-001-Miss.

Descriptors: *Atmospheric precipitation, *Rainfall, *Probability, Seasons, Computation, Meteorological data, Meteorology, Correlation techniques, Mississippi, Seasonal, Correlation analysis.

The purpose of this study was to define more accurately rainfall variations and the following objectives were designed to accomplish this goal: (1) to determine the probability of receiving less than a given amount of precipitation for weekly, monthly, seasonal, or yearly periods for 10 geographical regions in the State of Mississippi, and (2) to examine the rainfall of 1 period of time with that of another period for State College, Mississippi, to determine if the rainfall of the 2 periods could be correlated. The precipitation probability tables were designed for reference material for water-use system planners and designers. Conclusions to be drawn from this study lie not in the results themselves, but in uses made of these results.
W69-00623

THE USE OF EIGENVECTORS FOR CLIMATIC ESTIMATES,
Nevada Univ., Reno.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-00644

ANALYSIS OF QUASI-PERIODIC WEATHER DATA,
Connecticut Univ., Storrs, Civil Eng. Dept.
Chesley J. Posey.
Inst Water Resour Rep 3, Univ Connecticut, June 1967. 20 p, 19 fig, 9 ref, append. OWRR Project A-008-Conn.

Descriptors: *Weather data, Meteorology, *Analytical techniques, Turbulence, *Microenvironment.

Long-time records of daily maximum temperatures, already available on IBM cards, were studied to find out whether the frequency distribution of these values and of their first and second successive differences could serve the purpose of definitive identification, a goal that neither the harmonic analysis nor serial correlation methods have been able to achieve. Study was limited to records of up to 36 years, and included but three different geographical locations. The empirical evidence that each of the three frequency distributions tended to converge toward a fixed relationship as the period was lengthened was strong. The best discriminator between the locations seemed to be the distribution of daily maximums. The distributions of the first and second successive differences at the different stations were so similar as to give rise to formulation of an hypothesis of similarity of global atmospheric turbulence. The curves presented are of interest in comparing the climatological environments. A computer program is given which can be used to extend the study to include a wider range of data.
W69-00670

2C. Snow, Ice, AND Frost

A PRINCIPLE INVESTIGATION OF THE COMBINED HYDROLOGICAL AND MASS BUDGET OF A CRITICAL GLACIER BASIN ON THE RIM OF THE NORTH PACIFIC HIGH, ALASKA-CANADA BOUNDARY RANGE,
Michigan State Univ., East Lansing, Glaciological and Arctic Sciences Inst.
Maynard M. Miller.
Inst Water Res Prog Rep, Michigan State Univ, Feb 1967. 17 p, 3 fig. OWRR Proj B-002-Mich.

Descriptors: *Hydrologic budget, *Glaciers, Alaska, Hydrologic cycle, Weather forecasting, Ablation, *Water balance, Surface runoff, Melting, Heat budget.

This is a study of glacio-fluvial runoff as related to meteorological and hydrological conditions. Data are from the Lemon-Ptarmigan Glacier on the Alaska-Canada boundary range. The glacier is situated in the interaction zone between the main circulations of the continental anti-cyclone and the cyclonic North Pacific Low. This system is acutely sensitive to climatic perturbations of continental significance. The objective is to develop a prototype investigation of the water balance of a climatologically critical zone and to relate the trends of the water, ice, and heat budget to the long-term regional glacier pattern. This information will contribute to our ability to predict hydrological trends in other regions of North America. Measured runoff losses are compared with percolation water recaptured by freezing and capillary retention and with the total retained solid water. The water-ice budget is analyzed and related to secular temperature and precipitation trends and to the shifting position of the Arctic front. Instrumentation and techniques used to facilitate the research include recording thermographs, precipitation and stream gages, ablation stake networks, seismic profiles,

standard meteorological equipment, test pits, and rammsonde profiles.
W69-00445

DEVELOPMENT AND TESTING OF SNOW PACK ENERGY BALANCE EQUATIONS,
Environmental Science Services Admin, Washington, D C.
E. A. Anderson.
Water Resour Res, Vol 4, No 1, pp 19-37, Feb 1968. 19 p, 12 fig, 1 tab, 18 ref.

Descriptors: Snow, *Snow surveys, *Snowmelt, *Energy balance, Melting, Runoff, *Runoff forecasting, Heat transfer, Thermodynamics, Mathematical analysis, Hydrology, Water sheds, Wind (Meteorology), Bibliographies, Models.
Identifiers: Mathematical models, *Snow pack.

A method was developed for computing the energy balance of a snowpack on a continuous basis. Estimates or measurements are required of net radiation or its components, air temperature, dewpoint, atmospheric pressure, amount and temperature of precipitation, surface snow density, and a wind function relating the vapor pressure gradient to moisture transfer. The 1954 Lower Meadow lysimeter studies showed good agreement between computed and observed values for snowpack runoff and snow surface temperature. A snowmelt and accumulation model was constructed by combining energy balance equations with relationships describing other components of the snowpack accumulation and ablation process. The Stanford Watershed Model is used to determine the time delay of water leaving the snowpack to the streamflow gaging station. The model gives a reasonable simulation of the observed mean daily flow hydrograph and seasonal areal snow cover plot using 5 yr of data from the Central Sierra Snow Laboratory. The model approximates the actual physical processes and will be valuable in future snow hydrology investigations. (USBR)
W69-00585

COMPARISON OF SNOW INTERCEPTION BY A HARDWOOD AND A CONIFER FOREST,
Maine Univ, Orono, School of Forestry and Water Resources Research Center.
C. E. Schomaker.
Res in the Life Sci, Vol 16, No 2, pp 35-43, Summer 1968. 9 p, 3 fig, 1 tab, 6 ref. OWRR Project A-005-Me.

Descriptors: *Interception, *Snow, *Rainfall, Snowmelt, Conifers, Hardwood, Pastures, Maine.
Identifiers: Snowfall interception.

The interception of snow and rain by a hardwood forest and a conifer forest near Orono, Maine are compared in a study made in 1965-1967. Interception by the conifers ranged from 35-37% of precipitation in winter and 27-35% in spring and summer. Interception by hardwoods ranged from 12-18% in winter and from 7-14% in spring and summer. In one study of snow accumulation on the ground, on Feb 2, snow depths were 16.0 in. under conifers, 24.5 in. under hardwoods, and 28.0 in. in open pasture. Snow melted off pasture first, followed by the hardwood and last, the conifer forest floor. (Knapp-USGS)
W69-00688

2D. Evaporation and Transpiration

PRELIMINARY LYSIMETRIC INVESTIGATIONS AT THE UNIVERSITY OF NEBRASKA FIELD LABORATORY, MEAD,
Nebraska Univ., Lincoln.
Norman J. Rosenberg.
Nebraska Water Resour Res Inst, Hort Proj Rep 60, 1966-1967. 111 p, 43 fig, 18 tab, 48 ref, 2 append. OWRR Project A-001-Nebr.

Descriptors: Advection, *Climatology, *Evapotranspiration, Estimating equations, Evapotranspiration control, Water conservation, *Lysimeters, *Regression analysis, Instrumentation, Bibliographies.

The installation of lysimeters, meterological instrumentation and data logging systems at the Nebraska Field Laboratory at Mead, Nebraska is discussed and illustrated. A preliminary study of wind conditions over the experimental field is included as well as lysimetric measurements of evaporation from bare soil during the summer and fall of 1966. Equations are developed through multiple regression techniques on commonly measured meteorological parameters to predict evaporation from bare soil. Effectiveness of antitranspirant materials on water economy of alfalfa summarized. (E. C. Reed-Nebr)
W69-00655

SOME EFFECTS OF CONTINUOUS ANTI-EVAPORATION FILMS,
Missouri University, Rolla and Texas A and M University, College Station.
Bobby G. Wixson, and William B. Davis.
Proc of 3rd Annu Amer Water Resources Conf, pp 170-174, Nov 8-10, 1967. 3 fig, 4 ref.

Descriptors: *Biochemistry, *Evaporation control, *Monomolecular films, Hexadecanol, Octadecanol, Algae, Bacteria, Oxygen demand, Biodegradation.
Identifiers: *Anti-evaporation films.

The ecological effects of a continuous anti-evaporation film of hexadecanol and actadecanol were studied in experiments designed to simulate field conditions as closely as possible without the size and complexity of natural systems. Light banks simulated sunlight energy, with photoperiods from 8 AM to 8 PM. Air and water temperatures were maintained at 22 deg C. The 20 gal glass aquaria were inoculated with pond water and algae for 3 consecutive 30 day tests. Half of the systems were filmed with a 1:1 mixture of hexadecanol and octadecanol at a rate of 0.05 pounds per acre per day. The number of bacteria increased in filmed systems, and biodegradation of the film caused oxygen demand. The film reduced oxygen diffusion rate by 10-15%. Initially algae growth was inhibited but the biodegradation of the film added nutrients which were used by some species of algae which increased in growth after 15 days. Reduced surface tension caused some algae to sink instead of float. (Knapp-USGS)
W69-00699

2E. Streamflow and Runoff

FLOODS FROM FOREST COMPARED TO THOSE FROM FARMLAND,
Colorado State University, Fort Collins.
Songthara O. Kar.
Interim Rep, Natur Resour Center, Colo State Univ, June 1967, 124 p, 4 fig, 16 tab, 2 appnd, 57 ref, disc. OWRR Project A-002-Colo.

Descriptors: *Floods, Watersheds (Basins), Watershed management, Cultivated lands, Forests, Grasslands, Deserts, Flood forecasting, Forecasting, *Hydrographs, Computers, Analysis, *Runoff, *Runoff forecasting.
Identifiers: Flood frequency.

An exploratory study on floods from forest compared to those from farmland was performed as an extension of a thorough study of hydrograph rise times. Fifty-one watersheds were classified, using as a criterion the watershed coverage, into 4 groups: forest, cultivated, grass, and desert. Equations for predicting rise times and 10-yr flood peaks were derived in simple and multiple regression analyses by computer. The best equations obtained were used to study the effects of changing the watershed coverage on rise times and flood peaks by using 2 average watersheds. No conclusions concerning the trend of behavior of watersheds compared are warranted. Detailed information on watershed coverage and condition must be secured before any further work is to be performed.
W69-00398

SOME ASPECTS OF TIME SERIES ANALYSIS IN HYDROLOGIC STUDIES,
U S Geological Survey, Washington, D C.
N. C. Matalas.
Proc of Hydrol Symp No 5, National Research Council of Canada, pp 271-309, Feb 1966. 39 p, 50 ref.

Descriptors: *Time series analysis, *Hydrology, *Streamflow forecasting, Mathematical studies.

Statistical techniques used to study the characteristics of hydrologic time series are reviewed and their use is explained. In time series analysis, an attempt is made to estimate and reconstruct the properties of the generating process of a phenomenon from the observed time series followed by the phenomenon. The estimates are made in either the time or frequency domain by the use of covariance or spectral functions, each of which is a Fourier transform of the other. Covariance seems the more appropriate for extrapolation into future time, but spectral techniques are easier to use to predict responses of river systems to stochastic inputs, particularly with linear systems. Autocorrelation in stationary hydrologic time series of annual events is attributed to storage and to persistence in precipitation and evapotranspiration, and much of the variance is accounted for by low frequencies. Annual floods have very little serial correlation. The assumption of first-order linear autoregression processes to account for effects of persistence is practical because the mathematical operations are tractable. (Knapp-USGS)
W69-00422

A MATHEMATICAL MODEL FOR SIMULATING THE HYDROLOGIC RESPONSE OF A WATERSHED,
Purdue Univ, Lafayette, Ind.
L. F. Huggins, and E. J. Monke.
Water Resour Res, Vol 4, No 3, pp 529-539, June 1968. 11 p, 9 fig, 1 tab, 14 ref.

Descriptors: *Watersheds, *Simulation, Runoff, Surface runoff, Storms, *Mathematical analysis, Drainage basins, Infiltration, Hydrographs, Soil moisture, Models, Slopes, Outflows, Hydrology, Grid systems.
Identifiers: *Mathematical models, Small watersheds, Rainfall-runoff relation, Interception, Storm runoff, Inflow.

A general mathematical model was developed to simulate surface runoff from watersheds. Based upon integration of the concepts of physical hydrology into quantitative relationships, the model avoids the use of lumped parameters by delineating the watershed as a grid of small independent elements. The resultant freedom from fundamental assumptions of the form of the system equations and from the permissible small areal resolution of the model permits study of complex combinations of watershed and storm conditions. Application of the model to two small watersheds indicated that additional research is needed to better define the relationships for surface runoff and infiltration and to improve the reliability of simulated runoff hydrographs. (USBR)
W69-00568

A NUMERICAL SOLUTION OF THE EQUATIONS OF MOTION AS APPLIED TO SURFACE FLOW,
New Mexico State Univ., University Park.
Ahmed Yousef Abdel-Razaq, and John W. Hernandez.
Eng Exp Sta, Tech Rep 36, Dec 1966. 90 p, 15 tab, 30 ref, 2 append. OWRR Project A-001-NMex.

Descriptors: Hydrology, Urban hydrology, Runoff, *Surface runoff, Hydraulics, Open channels, Watersheds (Basins), *Numerical method, Flood routing, Computer models, Synthetic hydrology, *Overland flow, Unsteady flow, *Motion, Rainfall, Impervious soils, Equations, Bibliographies, Demonstration watersheds.
Identifiers: Watershed studies, Surface hydrology.

A new technique is presented for the solution of the unsteady flow equations for the ideal case of a constant-slope open channel with lateral inflow. Lateral inflow is assumed to be constant with distance but variable in time. The proposed techniques may be applied to the solution of problems of surface runoff. The one-dimensional, non-linear, partial differential equations of motion and continuity are derived and transformed into a system of ordinary, nonlinear, differential equations. This set of equations may then be solved numerically to give the velocity, depth of flow, or area, at any point along the channel. The numerical procedure consists of solving the equations for the derivatives of the velocity and depth, or area, with respect to time at each nodal point along the channel for a particular time. Starting with the known initial conditions and utilizing Taylor's series, the velocity and the depth, or the area of flow, can be predicted after an increment of time. The numerical solution was shown to converge.
W69-00636

REGIONAL DRAFT STORAGE RELATIONS IN WEST-CENTRAL ALABAMA,
U. S. Geological Survey, Tuscaloosa, Alabama, Water Resources Division.
Patrick O. Jefferson.
U S Geol Surv Prof Pap 600-C, pp C182-C184, 1968. 3 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Water resources, *Surface waters, *Draft-storage curves, *Water yield, *Safe yield, Water storage, Watershed management, Streamflow, Discharge (Water), Alabama.
Identifiers: *Draft-storage relations, Median 7-day low flow.

In a 10-county region of west-central Alabama, within-year storage can provide draft rates ranging up to 50% of the average flow of streams. Storage requirements can be estimated on the basis of average flow alone, but the standard error of estimate can be reduced by including median 7-day low flow as a secondary variable. Multiple regressions for estimating storage requirements for draft rates of 25 to 50% of the average flow are combined in a single coaxial diagram which has regional application. Draft-storage frequency curves and curves showing regional relations between storage required and average flow are presented. (Knapp-USGS)
W69-00682

SERIAL CORRELATION OF ANNUAL FLOODS,
U S Geological Survey, Washington, D. C., Water Resources Div.
P. H. Carrigan, and Carl S. Huzzen.
Proc of the 12th Congr, Int Hydrol Symp, pp 322-328, Sept 1967. 7 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Time series analysis, *Floods, *Streamflow, *Stochastic processes, Markov processes.
Identifiers: Annual floods.

A study of streamflow records of 45 gaging stations, well distributed over the United States, was undertaken to determine serial correlation of annual floods, to seek stochastic processes most descriptive of serial correlation, and to relate serial correlation to hydrologic variables. The first- and second-order serial correlation coefficients for annual floods appear to be greater than zero at a significant number of the sites considered in this study. No dominant stochastic process was found in study of these records. The possibility of serial correlation of annual floods appears to increase if base flow enhances the magnitude of flood discharges. First-order serial correlation coefficients of annual flows and of annual floods seem to be directly related. (Knapp-USGS)
W69-00686

RESISTANCE TO FLOW IN SAND CHANNELS,
U S Geological Survey, Fort Collins, Colorado.
Everett V. Richardson, and Daryl B. Simons.
Proc of the 12th Congr, Int Ass for Hydraul Res, pp 141-150, Sept 1967. 10 p, 4 fig, 12 ref.

Descriptors: *Alluvial channels, *Channel morphology, *Flow resistance, *Regime, Roughness (Hydraulic), Equations.
Identifiers: Navier-Stokes equation.

Relations are presented for estimating resistance to flow for plane bed, rippled bed, dunes, and antidunes. With plane bed, energy dissipation results from grain roughness. With ripples, it results from form roughness. With dunes, it results from form roughness and grain roughness if dunes are small in comparison to the scale of the system. If dunes are so large that they cannot be considered roughness elements but changes in cross section, then energy dissipation also results from the acceleration and deceleration of the flow as well as from the grain and form roughness. With antidunes, energy dissipation results from grain roughness, acceleration and deceleration of the flow and breaking waves. There is not a general resistance-to-flow equation for equilibrium flow in a sand channel because (1) bed configuration determines whether the flow is uniform or nonuniform and steady or unsteady; (2) there are 4 types of energy dissipation; and (3) there is a range in shear stress (transition) where bed form may range from dunes to plane bed or antidunes. A relation is also given for predicting bed from given stream power and sand size. (Knapp-USGS)
W69-00687

FLOODS FROM HURRICANE BEULAH IN SOUTH TEXAS AND NORTHEASTERN MEXICO, SEPTEMBER-OCTOBER 1967,
U S Geological Survey, Austin, Texas, Water Resources Division.
R. V. Grozier, D. C. Hahl, and A. E. Hulme.
Tex Water Develop Board Rep 83, 195 p, Sept 1968. 38 fig, 14 tab.

Descriptors: *Floods, *Texas, *Mexico, *Historic flood, *Hurricanes, *Rain, Discharge (Water), Regional floods, Stage-discharge relations, Rio Grande.
Identifiers: *Hurricane Beulah, Estuary dilution, Record rainfall.

Floods produced by Hurricane Beulah during Sept and Oct 1967 exceeded maximum previous stages on 5 Texas river basins by amounts ranging from 2.7 ft at Guadalupe River near Tivoli to 9.2 ft at Arkansas River near Skidmore. Medio Creek near Beeville had a discharge 4.12 times the previous maximum and 6.0 times the 50-yr flood. The inflow to Lake Corpus Christi was over 4.5 times the volume of the lake. Corpus Christi Bay received 1.5 times its normal volume and San Antonio bay, 3 times its volume. Most of the saline water was flushed out. Water levels rose in shallow wells because of infiltration of floodwater and rainfall, and because of water pouring into many flooded wells. Flooding along the Rio Grande exceeded all previous maximum measurements. A 4000 sq mi area of South Texas was inundated. Rainfall of 25 in. was common in Texas and as much as 35 in. was measured in Mexico. Precipitation, discharges, water quality, and groundwater levels are tabulated. (Knapp-USGS)
W69-00690

METHOD OF VOLUME-DIVERSION ANALYSIS OF A STREAM,
U S Geological Survey, Washington, D. C., Water Resources Division.
M. R. Collings.
U S Geol Surv Prof Pap 600-C, pp C199-C203, 1968. 5 p, 4 fig, 2 tab, 3 ref.

Descriptors: *Diversion, *Water management (Applied), *Duration curves, *Prior appropriation, Hydrographs, Statistical methods.
Identifiers: Volume-diversion analysis, Millers River, Mass, Flow frequency.

A simple method is proposed for estimating the probability of the potential volume of diversion available after prior demands on flow are satisfied downstream from a selected diversion site. The volume of divertable flow obtainable in excess of a specified discharge is computed from the selected class discharge limits used in calculating flow-duration data. The magnitude and frequency of these volumes are then determined. From the analysis of mean daily flows, relations can be derived to determine (1) potential volume of diversion, (2) recurrence interval, (3) size or rate of diversion, and (4) probable number of days in a year when diversions are possible. The results of an analysis of Millers River, Massachusetts are presented in the form of frequency curves. (Knapp-USGS)
W69-00694

THE BOUNDARY CONDITIONS IN THE IMPLICIT SOLUTION OF RIVER TRANSIENTS,
U S Geological Survey, Washington, D. C., Water Resources Division.
Chintu Lai.
U S Geol Surv Prof Pap 600-C, pp C204-C210, 1968. 7 p, 3 fig, 7 ref.

Descriptors: *Unsteady flow, *Streamflow, *Stage-discharge relation, *Mathematical studies, *Digital computers, Computer programs, Open channel flow, Velocity.
Identifiers: *River transients, *Boundary conditions, Finite-difference methods, Implicit method.

Transient riverflow in a given reach at a particular time can be defined by partial differential equations and appropriate boundary conditions. Consideration of physical properties of the riverflow gives 4 different sets of boundary conditions. In solving these equations using the implicit method all unknowns at the advanced time line have to be found simultaneously; therefore, different combinations of known boundary data leave different sets of unknown to be solved implicitly. Computer programs have been written to handle different boundary-value problems separately. Test runs have indicated that transient flows with all 4 boundary conditions can be treated adequately, and have shown that good agreement exists between computed and observed values. The boundary conditions treated are: (1) Stages given at the upstream and downstream ends of the reach; (2) Discharges given at each end; (3) Stage given at the upstream end and discharge at the downstream end; (4) Discharge given at the upstream end and stage at the downstream end. (Knapp-USGS)
W69-00697

AN IMPLICIT METHOD FOR NUMERICAL FLOOD ROUTING,
North Carolina State University, Raleigh.
Michael Amein.
Water Resources Res, Vol 4, No 4, pp 719-726, Aug 1968. 8 p, 2 fig, 1 tab, 18 ref.

Descriptors: *Digital computers, *Floods, *Flood routing, *Mathematical models, Hydraulics, Unsteady flow, Open channel flow.
Identifiers: *Implicit method, *Numerical solutions, Partial differential equations, Digital computer method.

In application to flood routing, the numerical solution of the complete equations of unsteady flow is described. This implicit method is both fast and accurate and can be established based on: (+) a centered difference scheme for representing the primary differential equations in finite difference form, and (b) simultaneous solutions of the finite difference equations for each time step. The dif-

ference equations constitute a system of nonlinear algebraic equations that can be solved on a digital computer by rapidly convergent procedures based on the generalized Newton iteration method. A distinguishing feature of the linear system is that the matrix of coefficients contains few nonzero elements, which facilitate fast solutions. It was found that when the implicit method was applied to a number of representative problems in flood flows, the computations were stable and converged rapidly toward the final solutions. The method can be efficiently applied to the study of flood movement. (Llaverias-USGS)
W69-00700

2F. Groundwater

CORRELATION OF TRACE ELEMENTS IN GROUND WATER AND AQUIFERS WITHIN THE CONNECTICUT RIVER BASIN.

Water Resour Res Inst, Conn, May 1967. 4 p. OWRR Project A-007-Conn.

Descriptors: *Trace elements, *Aquifers, *Groundwater, Groundwater geology, Water quality, Minerals, Spectroscopy, Bedrock, Rocks, Chemical analysis.
Identifiers: Connecticut River Basin.

This paper is a notice of the completion of a OWRR research project. Ultraviolet emission spectrography was employed to obtain reasonably precise semiquantitative data for some trace elements of certain minerals from various bedrock units in Connecticut. The elements determine were Ag, Ba, Be, Ca, Cu, Ga, Mn, Pb, Sn, Ti, and Zr. Minerals analyzed were quartz, feldspars, biotite, and magnetite. Most of the elements (Ag, Ba, Be, Ga, Pb, Sn, and Ti) showed concentration variations that were systematically related to specific rock units. The above data constitute partial achievement of the immediate objectives of this project, which include: (1) the determination of trace element concentrations in minerals from bed rock units and in ground-water samples from various parts of Connecticut; and (2) sampling and analyses of minerals from aquifers (bedrock units and unconsolidated deposits) and ground water from the Connecticut River Basin and their correlation based on trace element concentrations.
W69-00399

REGIONAL GEOLOGY AND GROUNDWATER HYDROLOGY OF THE SAHIL AREA, TUNISIA,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00429

GROUND-WATER RESOURCES OF THE ACU VALLEY, RIO GRANDE DO NORTE, BRAZIL,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00430

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH,
U S Geological Survey.
R. W. Mower, and R. D. Feltis.
U S Geol Surv Water-Supply Pap 1854, 75 p, 1968. 15 fig, 7 plate, 9 tab, 38 ref.

Descriptors: *Water sources, *Groundwater recharge, *Utah, Water quality, Evapotranspiration, Groundwater movement.
Identifiers: *Sevier Desert.

A cooperative hydrologic study was made of the Sevier Desert to determine amount and location of recharge, discharge, pumpage, water storage, and pumping effects on water levels. Most recharge to groundwater reservoirs results from water entering alluvial fans as percolation from streams, irrigation ditches, and irrigated fields. Leakage from the Central Utah Canal is a major source of recharge to the water-table aquifer. Most groundwater is suitable for domestic and stock uses. Water discharged by withdrawal from wells increased from 2,000 ac ft in 1950 to 30,000 ac ft in 1964 and water levels declined from 4 ft to 7 ft for the same period. In the 440,000 acres of the Sevier Desert that support phreatophytes, and estimated 135,000-175,000 ac ft of groundwater is consumed by evapotranspiration. Consumptive waste of groundwater by vegetation of little or no value (principally saltcedar and pickleweed) is not great but will increase if saltcedar spreads into native meadow pastures, along canal and drain banks, and into surface reservoirs. About 120,000 ac ft of water can be obtained from storage by lowering the artesian aquifer water level 20 ft. (Llaverias-USGS)
W69-00432

GEOPHYSICAL LOGGING AND HYDRAULIC TESTING, PAHUTE MESA, NEVADA TEST SITE,
U S Geological Survey, Las Vegas, Nevada.
Richard K. Blankennagel.
Ground Water, Vol 6, No 4, pp 24-31, July-Aug 1968. 8 p, 9 fig, 11 ref.

Descriptors: *Borehole geophysics, *Logging (Recording), *Hydraulic properties, *Water wells, Electrical well logging, Tracers, Flowmeters.
Identifiers: *Testing, Packers, Caliper logs, Temperature logs.

Studies performed by the U S Geological Survey for the Atomic Energy Commission in relation to underground nuclear explosions at the Nevada Test Site involve geophysical logging and hydraulic testing in deep exploratory holes at Pahute Mesa. Electric logs are used to identify lithology, for correlation and to locate potential water-bearing zones, usually fractured welded tuff and rhyolote. Caliper logs are essential to determine borehole diameter for selection of packer seats, for tracer-survey computations, and for proper interpretation of other geophysical logs. Temperature logs indicate water movement and water entry into boreholes. Fluid resistivity logs are made at the same time as spontaneous potential logs to aid in spontaneous potential interpretation and to detect zones of fresh water entry. Tracer surveys and flow meters are used to study water circulation. Hydraulically inflated straddle packers are used in water injection and swabbing tests for water yielding potential of isolated intervals in the borehole. Static water levels of selected intervals are also obtained. (Knapp-USGS)
W69-00434

THE RELATIONSHIP BETWEEN SPECIFIC CAPACITY AND AQUIFER TRANSMISSIBILITY IN THE HOUSTON AREA, TEXAS,
U S Geological Survey, Houston, Texas.
R. K. Gabrysch.
Ground Water, Vol 6, No 4, pp 9-14, July-Aug 1968. 6 p, 6 fig, 1 tab, 4 ref.

Descriptors: *Water wells, *Aquifers, *Specific capacity, *Pump testing, *Transmissivity, Well screens, Aquifer characteristics, Hydraulics, Storage coefficient.
Identifiers: *Well efficiency, Pumping tests, Recovery tests, Well development, Houston, Texas.

Tests of wells owned by Houston, Texas were analyzed and comparison of the results with theoretical transmissibility-specific capacity curves showed that the wells are not completely developed. Average thickness of sand beds screened ranges from 340-605 ft in the 7 well fields. The 55 tests showed ranges in aquifer permeability from 125-432 gpd per sq ft, and ranges in average transmissivity from 96,000 to 172,000 gpd per ft. Measured specific capacities were based on 1-hour recovery tests. Shorter tests showed misleading higher values. All were lower than calculated theoretical values. Wells drilled since 1955 averaged 69% of theoretical transmissivity and wells drilled before 1955 averaged 72%. The better performance of the older wells may be because of gradual development by pumping through the years. It is suggested that well drillers employ 1-hour or longer, properly conducted recovery tests to determine whether wells are properly constructed and developed. (Knapp-USGS)
W69-00435

POINT DILUTION METHODS OF INVESTIGATING GROUND WATER FLOW BY MEANS OF RADIOISOTOPES,
Walter Drost, Dietmar Klotz, and Arnd Koch.
Water Resour Res, Vol 4, No 1, pp 125-146, Feb 1968. 22 p, 15 fig, 3 tab, 30 ref.

Descriptors: *Tracers, *Radioactive isotopes, Dyes, Ground water, *Wells, Dams, Permeability, Piezometers, Porous materials, Model tests, Underseepage, Field tests, Seepage, Bibliographies, *Groundwater flow.
Identifiers: Radiation detectors, Gold isotopes, Foreign testing, West Germany, *Dilution method, *Water wells.

The distortion of the flow field by a well must be known to apply the point dilution method of measuring ground-water flow by tracers. The distortion can be calculated if aquifer permeability is less than or equal to gravel pack permeability, and if gravel pack permeability is less than or equal to well screen permeability. The tracer must be adequately mixed during the dilution procedure. Experiences obtained from model tests are applied to field investigations. Peak-to-peak and total count methods were used in wells having a vertical flow to determine depths and rates at inflow and outflow. The direction of ground-water flow was determined by the point dilution method; a radioactive tracer is injected into the well screen water column and measured by a collimated probe that is sensitive to the direction of incident radiation. Using tracers that are fixed on the soil is advisable; Gold 198 is the most suitable tracer. Strong, vertical currents in a well present a serious obstacle to field measurements of the rate and direction of ground-water flow. (USBR)
W69-00587

WATER-LEVEL PROBE,
National Reactor Testing Station, Idaho Falls, Ida.
K. H. McGary, M. Wilhelmsen, and P. Boren.
J Hydrol, Vol 6, No 3, pp 225-236, June 1968. 12 p, 8 fig.

Descriptors: Instrumentation, Measuring instruments, Wells, Sensors, Water surface, Water surface profiles, *Liquid level gages, Electrodes, Recording systems, Electrical conductance, Ground water, Phreatic line, Water table, *Water stage recorders.
Identifiers: *Water level, Water wells, Probes (Instruments).

A water-level probe designed for recording surface levels in wells can be applied to any system requiring monitoring and control of liquid levels. Desirable features of the instrument were: a probe for small-diameter well casing; self-contained, lightweight, and rugged; operable over long periods without battery replacement or maintenance; sealed against wind, dust, rain, and snow; able to withstand temperature variations from 100 deg F to minus 40 deg F; and exhibiting an accuracy of plus or minus 0.02 ft at well depths of 600 ft. The major problem encountered was designing a sensitive and reliable probe. Probes using water conductivity as the sensing mechanism became corroded, lost conductivity, and gave erroneous readings because of water and mineral salt bridging the electrodes. Three types of probes were developed to overcome these problems. One was a float-operated mercury switch not dependent on water conductivity; the other 2 were conductive probes using stainless steel

with long pointed electrodes. Design details, applications, and precautions are given for using the probes. (USBR)
W69-00591

TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES,
Birmingham Univ, Great Britain.
Robin Herbert.
J Hydrol, Vol 6, No 3, pp 237-264, June 1968. 28 p, 17 fig, 2 tab, 12 ref.

Descriptors: Ground water, *Groundwater flow, *Electric analogs, Time, Steady flow, Analogs, Two-dimensional, Water table, *Drawdown, Models, Movements, Mathematical analysis, Three-dimensional, Wells, Electrical resistivity.
Identifiers: Mathematical models, Great Britain.

A sudden water table movement may cause earth dams to collapse, riverbanks to fall, wells to run dry, or heavy machinery to bog down in saturated soil. A general method for simulating unconfined ground-water flow is available for predicting and minimizing such an occurrence. Factors governing water table movement are described, and a method for studying the flow is developed. The technique represents the continuous fall of the water table in a stepwise manner; a method is described for smoothing out discontinuities induced by such a technique. The solution to a simple problem is presented with experimental details to demonstrate how the technique is applied to a network analog modeling time-variant flow. The technique is tested against alternative solutions of flow systems in: (1) two dimensions, (2) three dimensions, and (3) radial symmetrical form. Accuracy of the analog solution is high. Isolated solutions of certain idealized unconfined flow systems existed prior to this work; however, any three-dimensional time-variant unconfined ground-water system may be represented, using the technique described. (USBR)
W69-00594

IN-SITU DETERMINATION OF AQUIFER PARAMETERS FOR USE IN THE DRAINAGE FUNCTIONS,
Utah State Univ, Logan.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00602

ANALYSIS AND PREDICTIVE METHODS FOR GROUND WATER FLOW IN LARGE HETEROGENEOUS SYSTEMS,
Battelle Memorial Institute, Richland, Wash.
R. William Nelson, and Dennis B. Cearlock.
Pap, Proc Ser No 4, Symp Amer Water Resour Ass, San Francisco, Calif pp 301-318, Nov 1967. 18 p, 9 fig, 12 ref.

Descriptors: *Ground water, *Groundwater flow, Permeability, Aquifers, Porous materials, Heterogeneity, Water table, Forecasting, Mathematical analysis, *Boundary values, Computer programming, Analysis, Reservoirs, Energy dissipation, Hydrology.
Identifiers: Ben Franklin Resvr, Wash, Hanford Project, Wash, Boundary conditions, Groundwater management, Mathematical models.

Ground-water flow in heterogeneous porous materials was analyzed to determine the effects on the ground-water system of the proposed Ben Franklin Reservoir in Wash. The analysis method has 3 parts: (1) in-place determination of invariant flow system characteristics; (2) predicting new flow conditions from altering boundary conditions; and (3) using predicted results to answer practical problems such as the possible movement of contaminants. The paper discusses a new energy dissipation method for in-place permeability measurement to determine distribution. Permeability distribution and boundary conditions are used to set up a new boundary value problem. The boundary value problem interrelates all pertinent variables and provides a skeleton model for predicting future ground-water flow conditions. The solution gives new ground-water potentials resulting from changes in boundary conditions. The analysis sequence gives a better representation at actual field conditions and offers advantages of directly specifying field data required, which will realize savings by eliminating nonessential traditional field measurements. (USBR)
W69-00604

EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
US Geological Survey, Denver, Colo.
Robert W. Stallman.
Pap, Proc Ser No 4, Symp Amer Water Resour Ass, San Francisco, Calif, pp 126-134, Nov 1967. 9 p, 4 fig, 18 ref.

Descriptors: *Ground water, *Aquifers, Hydrology, Moisture content, Permeability, Bibliographies, Groundwater flow, Drawdown, Time, Wells, Water table, Electric analogs, Radioactive isotopes.
Identifiers: Evaluation, Transmissibility coeff, Transmissivity, Theis nonequilibrium method, Leaky aquifers, Depth.

Complicated ground-water flow systems can be studied in detail by applications of electric analogs or digital computers. Aquifers and their response to applied stress could not be studied economically 15 yr ago. Examples of recently developed techniques are discussed. Graphs show: (1) comparisons of Theis and Hantush analyses of recovery data; (2) auxiliary-type curves from Boulton, showing match to drawdowns observed at midthickness in an unconfined aquifer; (3) apparent specific yield from measurements of moisture content; and (4) depth vs temperature in a formation having low permeability where ground-water flow is vertical. (USBR)
W69-00605

RECHARGE FROM INDUCED STREAMBED INFILTRATION UNDER VARYING GROUND-WATER-LEVEL AND STREAM-STAGE CONDITIONS,
Minnesota Univ., Minneapolis.
William C. Walton, David L. Hills, and Gordon M. Grundeen.
Water Resour Res Center Bull 6, June 1967. 43 p, 19 fig, 3 tab, 19 ref. OWRR Project A-014-Minn.

Descriptors: *Surface-groundwater relationships, Hydrographs, *Safe yield, Influent streams, Saturated flow, *Streambeds, *Streamflow, Aquifers, Artificial recharge, Permeability, Storage coefficient, Water table, Drawdown, Groundwater recharge, Observation wells, *Induced infiltration, *Analog computers.

Recharge from induced streambed infiltration can be estimated with data on streambed infiltration rates, surface water temperatures, ground water levels, and stream stages. However, estimates of recharge are not valid unless it is recognized that: rate of leakage through a streambed increases in direct proportion to declines in water table until water levels have receded to stages below the streambed; after the water table recedes below the streambed, rate of leakage remains constant and at a maximum value, provided stream stage and temperature do not change. Incorrect water table declines and incorrect potential yields of well fields will be computed if it is assumed that induced streambed infiltration continuously increases in direct proportion to drawdown beneath the streambed regardless of water table stage. An aquifer-stream system for which hydrogeologic data are available was studied using electric analog computers and analytical methods. Results of these computer studies demonstrate that much greater drawdowns are computed for an aquifer-stream system when maximum infiltration conditions are taken into account than when maximum infiltration conditions are ignored.
W69-00620

DESIGN AND CONSTRUCTION OF A HORIZONTAL VISCOUS FLOW MODEL,
Delaware Univ., Newark.
R. D. Varrin, and H. Y. Fang.
Lehigh Univ Affiliated Inst, Ground Water, Vol 5, No 3, July 1967. 7 p, 3 fig, 22 ref. OWRR Project A-004-Del.

Descriptors: Bibliographies, *Analog models, *Viscous flow, Ground water, *Groundwater flow, *Aquifers, Transformations, Model tests, Fluid flow, Porous media, Water wells, Drainage, Permeability, Underground water storage.

This horizontal viscous flow model with infinite areal extent can be used for most well flow problems, whether 2-dimensional or 3-dimensional, steady or nonsteady, single aquifer or multiaquifer. This model can be used in the field of soil mechanics for subsurface drainage problems. The design includes scale model analysis and the application of conformal mapping techniques for simulating an ideal aquifer. Construction, calibration, and test procedures for the model are described. The apparatus has proved to be a valuable research tool and an excellent teaching aid.
W69-00628

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., New Jersey.
Roger J. M. De wiest.
J Geophys Res, Vol 71, No 20, pp 4799-4810, Oct 1966. 12 p, 11 fig, 17 ref. OWRR Project A-004-Del.

Descriptors: *Hydraulic models, Model studies, *Non-uniform flow, *Aquifers, Water wells, Wells, Hydraulics, Mathematical models.

This paper appraises an analytical study of nonsteady flow to multi-aquifer wells by means of the flow in a horizontal Hele-Shaw apparatus. Design and calibration features of the analog are described in detail for a well which penetrates 2 parallel overlying aquifers of infinite extent. The agreement between analytical solutions derived from a mathematical model, neglecting well losses, and experimental results from the physical analog is found to be very good.
W69-00629

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., Princeton, N. J.
Roger J. M. De Wiest.
Prog Rep 1, Groundwater Flow Systems in Del-Md-Va-Peninsula, June 1966. 41 p, 9 fig, 15 ref. OWRR Project A-004-Del.

Descriptors: *Hydraulic models, Hydraulic engineering, Groundwater, Model studies, *Aquifers, Subsurface waters, Confined water, Fluid flow, Boundaries (Surfaces), Mathematical studies, Mathematical models, *Subsurface flow, *Unsteady flow, *Water wells.

The paper appraises an analytical study of nonsteady flow to multiaquifer wells by means of the flow in an horizontal Hele-Shaw apparatus. Design and calibration features of the analog are described in detail for the case in which a well penetrates 2 parallel overlying aquifers of infinite extent. The agreement between analytical solutions derived from a mathematical model, neglecting well losses, and experimental results from the physical analog is found to be very good.
W69-00630

GEOPHYSICAL PROSPECTING FOR GROUND WATER IN THE PIEDMONT AREA, ALABAMA,
Alabama Geological Survey and Auburn Univ.
Thomas J. Joiner, James C. Warman, and W. Leon Scarbrough.
Geol Survey Alabama Circular 42, 1967. 48 p, 17 fig, 1 tab, 14 ref. OWRR Project B-003-Ala.

Descriptors: *Ground water, *Groundwater geology, *Geophysics, Subsurface investigations, Explorations, Seismic investigations, Electrical resistivity, Magnetic properties, Alabama.
Identifiers: Seismic refraction, Heflin, Alabama, Piedmont.

The Piedmont is underlain by igneous and metamorphic rocks making location of ground water supplies very difficult. Ground water occurrence and movement in the Piedmont is controlled by topography, recharge and discharge, rock type, fracture systems, and type and thickness of saprolite. Approximately 12 sq mi in the Heflin area, Cleburne County, Alabama, were included in this study. Fractures within bedrock are the most effective avenues for ground water movement in this area, but domestic supplies can be produced from saprolite and alluvium overlying bedrock. Thick saprolite contributes to bedrock-fracture production by absorbing water from streams and rainfall and releasing it slowly to underlying fractures. Seismic methods were used with geologic, hydrologic, and topographic data to locate and define favorable areas for drilling. Faults or fracture systems appear to correlate with depressions on bedrock surfaces associated with thick saprolite zones. Seismic data indicate 25 prospective areas for test drilling. Resistivity data were used to confirm seismic depths to bedrock, and to locate gravelly zones in buried stream channels. Some of the buried alluvium is thick enough to be considered a potential aquifer.
W69-00654

GROUND-WATER CONTRIBUTION TO STREAMFLOW AND ITS RELATION TO BASIN CHARACTERISTICS IN MINNESOTA,
Minnesota Univ., Minneapolis.
E. A. Ackroyd, W. C. Walton, and D. L. Hills.
Minn Geol Surv Rep Invest 6, 1967. 36 p, 13 fig, 6 tab, 17 ref. OWRR Project A-009-Minn.

Descriptors: *Groundwater geology, *Groundwater, *Surface-groundwater relationships, Lakes, Forests, Wetlands, Hydrographs, Runoff, *Base flow, *Watersheds, *Minnesota, Drainage basins, *Streamflow.

Estimates of annual ground-water contribution to streamflow in 38 drainage basins of Minnesota by use of standard streamflow hydrograph separation methods permit determination of relations between ground-water runoff and such basin characteristics as geologic environment, precipitation and temperature, and percentage of lake and wetland cover. Generalized conclusions derived from analysis of the data are that ground-water runoff is: (1) least from glaciated basins that have surficial lake bed sediments or gray-drift ground moraine immediately underlain by relatively impermeable bedrock, and (2) greatest from glaciated basins that have surficial deposits immediately underlain by permeable bedrock or that have thick surficial loess deposits immediately underlain by permeable bedrock. Ground-water runoff is much greater from glaciated basins having red drift than from basins having gray drift. The rate of ground-water increases as annual precipitation increases. Lakes and wetlands sustain and regulate streamflow during rainless periods; if they were absent sustained streamflow from northern parts of the state would be greatly reduced.
W69-00660

FACTORS AFFECTING SOLUTION OF MANGANESE IN WELL WATER,
Rhode Island Univ., Kingston, Mech. Eng. and Applied Mech.
Frank J. DeLuise.
Water Resour Res Rep A-003-RI, June 1967. 11 p, 7 fig. OWRR Project A-003-RI.

Descriptors: *Manganese, *Wells, *Water, *Solubility, Water quality, Aquifers, *Groundwater, *Water wells.

This study was to determine the extent to which several factors affect the solubility of manganese in well water. Factors investigated were those which might normally or abnormally, because of pollution, be present in aquifer. The presence of carbon dioxide, organic material and microorganisms were determined to be the most significant factors. Most of the laboratory studies were conducted using manganese monoxide, manganese dioxide (most common in soils), and manganese carbonate. The study demonstrates that biological fermentation as an intracellular activity can dissolve manganese, and led to the suggestion of a manganese cycle in impoundment water.
W69-00662

NUMERICAL MODELING OF GROUND WATER FLOW,
Kansas Univ., Lawrence and Manhattan.
C. F. Weinaug, and D. W. Green.
Completion Rep, Water Resour Res Inst, Univ Kans, June 1966. 29 p, 15 fig, 3 ref, 2 append. OWRR Project A-002-Kan.

Descriptors: Groundwater, Aquifers, *Groundwater movement, Numerical analysis, Mathematical studies, Mathematical models, Computer programs, Digital computers, Groundwater recharge, Seepage, Infiltration.

A mathematical model of ground-water flow is being developed. The model basically consists of the numerical solution of the partial differential equations describing 2-phase, 2-dimensional flow in porous media, e.g., waterflow in the presence of partial air saturation. A digital computer is required in the solution technique. The mathematical model will be useful for such studies as an evaluation of methods of artificial recharge of ground-water aquifers or the determination of rate of flow between adjacent aquifers.
W69-00664

SEEPAGE FLOW THROUGH AN EARTH DAM,
Georgia Inst. of Tech., Atlanta, Civil Engineering Sch.
M. R. Carstens, and George D. May.
Water Resour Center, Ga Inst Tech, July 1966. 75 p, 21 fig, 3 tab, 11 ref. OWRR Project B-003-Ga.

Descriptors: *Groundwater movement, *Embankments, Seepage, *Earth dams, Impervious soils, Drainage systems, Isotrophy, Free surfaces, Water table, Phreatic lines, Saturation, Groundwater barriers, *Flow-nets, Two-dimensional, Homegeneity, Soil mechanics.
Identifiers: Charmonmans method, Laplaces equation, Cauchy-Riemann equation.

Charmonman's method for the numerical solution of Laplace's equation in two dimensions is described. With Charmonman's method, the solution is obtained in the complex-potential plane and is transformed back to the physical plane by use of the Cauchy-Riemann equations. The method is well suited for numerical solution of seepage problems which are bounded by streamlines and equipotential lines because the flow domain is rectangular in the complex-potential plane. Seepage flows involving a free surface are readily solved in this manner because the boundary conditions can be easily defined. The scheme is illustrated by numerical solution for seepage flow through an earth dam placed on an impervious base, having an upstream face of constant slope, and having a drainage blanket. Both the flow nets and the flow-net coordinates are presented for embankment slopes of 1 (vertical) on 1 (horizontal), 1 on 2, 1 on 3 and 1 on 4 and for three different penetrations of the drainage blanket. Comparison is made with a widely used approximation--a parabolic free surface.
W69-00665

FURTHER STUDY OF AQUIFER PERFORMANCE,
Illinois Univ., Urbana, Mining, Metall., and Petro. Eng. Dept.
Walter Rose.
Termination Rep, Water Resour Center, Univ Ill, Jan 1967. 6 p. OWRR Project A-002-Ill.

Descriptors: *Porous media, Numerical analysis, Free surfaces, Ground water, *Aquifers, *Groundwater flow.

This is a termination report of a study of performance of aquifers used for sources, storage, and conduits of water. The study resulted in the following publications: 'Reservoir Engineering Reformulated,' by Walter Rose, October 1966; 'Transport Through Interstitial Paths of Porous Solids,' Chapter 5 in Flow Through Porous Media, edited by R J M DeWiest (Academic Press, 1967, by W Rose); Ph D thesis of H D Fara titled 'On the Geometry of Porous Media' February 1967, University of Illinois; and Ph D thesis of Balbir Singh, 'Numerical Study of Time-dependent Free Surface Flow.'
W69-00674

NOTES ON THE GEOHYDROLOGY OF THE DAKOTA SANDSTONE, EASTERN NORTH DAKOTA,
U. S. Geological Survey, Grand Forks, North Dakota.
T. E. Kelly.
U S Geol Surv Prof Pap 600-C, pp C185-C191, 1968. 7 p, 3 fig, 17 ref.

Descriptors: *Hydrogeology, *Sandstones, *Aquifers, *North Dakota, Transmissivity, Permeability, Water quality, Water yield, Artesian wells.
Identifiers: *Dakota sandstone.

In eastern North Dakota the Dakota Sandstone consists primarily of unconsolidated fine sand. Transmissibilities are less than 50,000 gals per ft, and the coefficient of storage is about 0.0004. Total dissolved solids and fluoride content differ considerably from place to place; the silica concentration is lower than in water from the glacial drift. Maps show configuration of the top of the Dakota Sandstone, total dissolved solids concentration of water from the uppermost producing sands. The water quality data suggest that a major source of recharge is upward leakage from the underlying Red River Formation. (Knapp-USGS)
W69-00680

RELATION BETWEEN AQUIFER CONSTANTS AND ESTIMATED STRESS ON AN ARTESIAN AQUIFER IN EASTERN MONTANA,
U. S. Geological Survey, Denver, Colorado.
O. James Taylor.
U S Geol Surv Prof Pap 600-C, pp C192-C195, 1968. 4 p, 5 fig, 9 ref.

Descriptors: *Aquifers, *Confined water, *Stress, *Strain, Overburden, Compressibility, Permeability, Porosity, Potentiometric level, Storage coefficient, Montana.
Identifiers: *Aquifer constants, Fox Hills-Basal Hell Creek aquifer.

Studies show that the Fox Hills-basal Hell Creek artesian aquifer in eastern Montana is subjected to different vertical stress related to differences in the weight of the overburden, which is partly supported by the artesian pressure at the top of the aquifer. Aquifer tests indicate values of the coefficient of permeability which appear to correlate with the estimated vertical stress on the aquifer at the aquifer-test sites. The coefficients of storage also changes with the estimated vertical stress on the aquifer, according to data from sonic logs and theoretical studies. Accordingly, the coefficients of permeability and storage of the aquifer vary in space and may change during aquifer development. Graphs and diagrams show vertical stress and the

relation between permeability and stress on the aquifer skeleton. (Knapp-USGS)
W69-00681

SUMMARY OF GROUND-WATER HYDROLOGIC DATA IN MICHIGAN IN 1967,
U S Geological Survey, Lansing, Mich, Water Resources Division.
P. R. Giroux, and G. C. Huffman.
Michigan Dep of Conserv, unnumbered Bull, 108 p, 1968. 39 fig, 5 tab, 86 ref.

Descriptors: *Data collections, *Hydrologic data, *Water levels, *Water yield, *Water quality, Hydrographs, Water wells, Water level fluctuations, Michigan.
Identifiers: Periodic observations.

Records of groundwater levels in the principal aquifers, records of pumpage, summaries of public water supply facilities, and the effects of precipitation on groundwater levels are compiled for Michigan through 1967. Records of water levels in areas of heavy pumpage and in areas where changes are principally from natural influences are illustrated or tabulated to allow comparison between these types of water-level fluctuations. The water-levels and related data provide a day-to-day record for the evaluation of available groundwater supplies. The long-term records serve as a framework to which short-term records may be related. Observation well records include water levels, well location, depth, elevation, aquifer, and extremes of water level in the past record and in 1967. Pumpage by most major water users in 1967 is tabulated. Hydrographs are used to illustrate water level changes. Well yield, pumpage, storage facilities, treatment, quality of water, per capita use and trends of water levels are summarized. (Knapp-USGS)
W69-00698

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND-WATER TRACERS,
Texas A and M University, College Station, Texas.
A. Ray Jennings, and Melvin C. Schroeder.
Water Resources Res, Vol 4, No 4, pp 829-838, Aug 1968. 10 p, 2 fig, 3 tab, 16 ref.

Descriptors: *Tracers, *Radioisotopes, *Groundwater, Movement, Velocity, Distribution pattern, *Ion exchange, Adsorption.
Identifiers: *Groundwater tracers, Radioactivity.

Tracer appearance results from movement along the most direct flow path, and thus arrival of the maximum concentration is the best index for determining average water velocity. Antimony 121, cerium 141, chromium 51, indium 114, ruthenium 103, and strontium 85 in chelate form were tested, as the unchelated ions are subject to greater delay by adsorption and ion exchange. Distribution-coefficient measurements were made under static conditions for crushed illitic shale and limestone. These measurements can be used to predict the elution history of a tracer from an exchange column. Comparisons of the predictions, the tracer elution histories, and elution histories for chloride pulses indicate that chelated chromium 51 is an adequate groundwater tracer. Average velocity of groundwater is equal to the sum of the tracer velocity plus the product of the tracer velocity, the distribution coefficient, and the bulk density of the aquifer divided by its effective porosity. The distribution coefficient for an ideal tracer is zero; the average velocity of this tracer is equal to the average groundwater velocity. (Knapp-USGS)
W69-00701

2G. Water in Soils

SEASONAL MOVEMENT OF PERCOLATING WATERS TO THE GROUND WATER TABLE UNDER HARDWOOD FORESTS IN MICHIGAN,
Michigan State Univ, East Lansing.
Donald P. White.
Term Rep, Dep Forest, Mich State Univ, June 1967. 51 p, 7 fig, 9 tab, 5 ref, append. OWRR Project A-006-Mich.

Descriptors: Hydrologic cycle, *Ground water, Artesian water, Soil moisture, Aquifers, Observation wells, *Water table, *Deep percolation, Precipitation (Atmospheric), Seepage, Field capacity, Michigan, Wells, Forest soils.
Identifiers: Piezometric surface, Soil water storage.

Hydrologic and geologic investigations of ground water at two forested sites in south-central Michigan indicated that direct measurement of recharge to the ground water table by recording wells was greatly confounded by artesian aquifers and uncontrollable regional hydrologic effects. A soil moisture budget for a period of subnormal precipitation, 1961 and 1967, was determined and ground water recharge estimated at one of the study sites. The annual cyclic pattern is similar for each year, but varies in magnitude of fluctuations dependent upon quantity and distribution of precipitation. Precipitation during the study period was 68% of normal. Infiltration of precipitation during growing season normally does not penetrate to depths greater than 3 ft. Depletion occurs at all depths within the measured 9-ft profile but not at equal rates. Changes in total soil moisture storage are partitioned into recharge, evapotranspiration, and deep seepage losses. The deep seepage component is estimated from the total soil moisture depletion curve and from assumed evapotranspiration rates. Deep seepage losses account for 1.31 in. of precipitation available as ground-water recharge during the growing season.
W69-00420

AN ANALYSIS OF THE VERTICAL INFILTRATION OF WATER INTO SOIL COLUMNS,
Arizona Univ., Tucson.
John L. Thames, and D. D. Evans.
Water Resources Res, Vol 4, No 4, pp 817-828, Aug 1968. 12 p, 10 fig, 4 tab, 8 ref.

Descriptors: *Infiltration, *Soil, *Porous media, *Soil density, Regression analysis, Flow characteristics.
Identifiers: *Flux equations, Vertical water infiltrations.

To investigate the behavior of soil water movement during infiltration and thereby determine the applicability of flux equations involving soil water content gradients as the apparent driving force, an experimental study was made of vertical infiltration of water. Sandy-loam and silt-loam soil materials were used as experimental media. Water was allowed to enter air-dry columns of soil at a small constant suction, and the subsequent distribution was followed with a gamma radiation attenuation device. An analytical expression of water content as a function of depth and time was obtained by multiple regression analysis, from which it was possible to determine the instantaneous flux and the water concentration gradient at given water contents. Nonlinearity at low water gradient was evidenced for both soils throughout a wide range of water contents; the magnitude and direction of departure from linearity were similar for both soils. A new empirical flow equation was obtained by modifying the diffusivity equation for unsaturated flow. Under this modification, derived by raising the water-content gradient to a power greater than unity, the parameter analogous to soil-water diffusivity becomes a function of both water content and water-content gradient. (Llaverias-USGS)
W69-00443

FLOW AROUND A VERTICAL SHEETPILE EMBEDDED IN AN INCLINED STRATIFIED MEDIUM,
Northwestern Univ, Evanston, Ill.
For primary bibliographic entry see Field 08D.
For abstract, see .
W69-00584

A NUMERICAL METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE AND EVAPORATION OF WATER FROM SOIL,
Agricultural Research Service, Fort Collins, Colo; University of Illinois, Urbana.
R. J. Hanks, and A. Klute.
Pap 68-214, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 16 p, 7 fig, 1 tab, 8 ref.

Descriptors: *Numerical method, *Infiltration, Drainage, *Evaporation, Moisture content, Soils, *Soil moisture, Computer programming, Boundary values, Hysteresis, Water table, Diffusion, Soil science, Wetting and drying tests.
Identifiers: Soil columns, Soil moisture movement, One-dimensional, *Soil-water relationship, Potential evaporation, Conductivity.

A numerical method was developed for estimating one-dimensional infiltration of water into soil where water added by precipitation at the surface was equal to or greater than the infiltration rate. The method estimated redistribution of water within the soil after precipitation had stopped, taking into account hysteresis in the water content-pressure relation. Drainage into a water table was considered. The method allowed for evaporation at a rate determined by external climatic conditions or at a rate determined by internal soil conditions. Graphs are given of: (1) water content-pressure relations; (2) cumulative flow-time relations and water content profiles for an infiltration, redistribution, evaporation problem; (3) water content profiles after redistribution, using wetting and drying curves with and without hysteresis; and (4) cumulative flow, water content profiles, and pressure profiles for a drainage-evaporation problem. (USBR)
W69-00589

EXPERIMENTAL EVALUATION OF INFILTRATION EQUATIONS,
Purdue Univ, Lafayette, Ind.
R. W. Skaggs, L. F. Huggins, and E. J. Monke.
Pap 68-213, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 26 p, 6 fig, 3 tab, 18 ref.

Descriptors: *Infiltration, *Experimental data, Analysis, Soils, Time, Soil erosion, Surface runoff, Bibliographies, Erosion, Field tests, Soil moisture, Soil physical properties, Runoff, Soil science, Agriculture, Hydrology.
Identifiers: Evaluation, Rainfall-runoff relation, *Infiltration rate, Equations, Rainfall simulators, Wetting front, Regression analysis.

An analysis of infiltration equations proposed by Green and Ampt, Hortan, Phillip, and Holtan was made using experimental data obtained in erosion studies with a plot-size rainfall simulator. An overland flow analysis was used to determine the infiltration rate-time relationship from the runoff hydrograph. Regression fits of the 4 equations to experimental data for 52 tests on 13 soils showed that all of the equations adequately described the infiltration rate-time relationship. Values of the equation parameters for each run analyzed are presented in the paper. (USBR)
W69-00600

SALT-WATER INTRUSION EFFECT OF A FRESH-WATER CANAL,
Georgia Inst. of Tech., Atlanta, Civil Eng. Sch.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00667

GRAVIMETRIC PRESSURE CELL INVESTIGATION OF HYSTERESIS AND HYDRAULIC CONDUCTIVITIES IN SOILS,
Ministry of Agriculture, Cambridge, England and Michigan State University, Ann Arbor.
E. U. Nwa, R. J. Kunze, and E. H. Kidder.
Quart Bull of Mich Agr Exp Sta, Vol 50, No 4, pp 559-569, May 1968. 11 p, 10 fig, 2 tab, 17 ref.

Descriptors: *Hydraulic conductivity, *Soils, *Soil moisture, *Hysteresis, Percolation, Laboratory tests, Methodology.
Identifiers: *Gravimetric pressure cell, Sandy loam.

The moisture content-pressure relationships of 5 samples of Hillsdale sandy loam and Sim's loam soils were measured, and the reproducibility of hysteresis loops was tested by using the same pressure steps for each absorption-desorption cycle. In each sample the total volume of water expelled during desorption was greater than the total volume taken in during absorption in the first run. This was caused by the smaller volume of air trapped in initial saturation; on 3 samples in subsequent runs the absorbed and desorbed moisture were equal because entrapped air remained constant. The 2 samples with high organic content absorbed more and more water in subsequent runs. It was not possible to reproduce the moisture content-suction curves. It is concluded that the history and experimental conditions must be specified when reporting the characteristic parameters for soils, and the assumption of a unique relationship between the calculated hydraulic conductivity and the moisture content was not valid for these data. (Knapp-USGS)
W69-00703

2H. Lakes

CHEMICAL QUALITY OF SURFACE WATERS IN DEVILS LAKE BASIN NORTH DAKOTA, 1952-60,
U S Geological Survey, Water Resources Division.
High T. Mitten, C. H. Scott, and Philip G. Rosene.

U S Geol Surv Water-Supply Pap 1859-B, pp B1-B42, 1968. 41 p, 9 fig, 1 plate, 11 tab, 14 ref.

Descriptors: *Water quality, *Surface waters, *Saline lakes, Salts, Chemical precipitation, North Dakota, Reclamation, Recreation demand, Data collections.
Identifiers: Devils Lake Basin, North Dakota.

The quality of water in the Devils Lake Basin, North Dakota, was studied between 1952 and 1960 to add data to earlier collections and to describe in better detail factors affecting the water quality of the area, as part of a tentative water quality and lake-level restoration plan. Lake levels have generally declined by evaporation since about 1800 and concentrations of dissolved salts reached 8,680 ppm in Devils Lake and 127,000 ppm in eastern Stump Lake. Above average rainfall raised lake levels in 1954, 1956, and 1957 to the highest levels in forty years. Concentration of salts decreased to 6,000 ppm in Devils Lake. The major dissolved constituents in the lake waters of the basin are sodium and sulfate. Salt balance computations indicate that as much as 35,000 tons of salts precipitated from Devils Lake in dry years, and in some wet years 89,000 tons were redissolved. Between 1952 and 1960, 201,000 tons were deposited on the bed of East Devils Lake, 15,100 tons in Stump Lake, and 421,000 tons in eastern Stump Lake. It is estimated that not more than 20% of the total amount deposited in the lowering of the lakes will redissolve if lake levels are raised. (Knapp-USGS)
W69-00424

PLANKTONIC PHOTOSYNTHESIS AND THE ENVIRONMENT OF CALCIUM CARBONATE DEPOSITION IN LAKES,
Minnesota Univ., Minneapolis, Limnological Res Center.
Robert O. Megard.
Interim Rep 2, Univ Minnesota, Jan 1968. 47 p, 7 fig, 6 tab, 33 ref. OWRR Proj A-008-Minn.

Descriptors: *Photosynthesis, *Calcium carbonate, Aquatic environment, Aquatic productivity, Eutrophication, *Lakes, Limnology, *Plankton, Algae, Bibliographies, Chemical precipitation, Ions, Biochemical oxygen demand, Minnesota, Water chemistry, Biodegradation.

Calcium and alkalinity concentrations increase in a productive lake during winter and the water at all depths becomes undersaturated with calcium carbonate. Soon after ice melt, the entire water column becomes oversaturated with calcium carbonate, and calcium and alkalinity concentrations decrease during spring, summer, and autumn. When the lake becomes thermally stratified, carbonate oversaturation increases at depths in which photosynthesis occurs, but the water at greater depths becomes undersaturated. Carbonate saturation appears controlled by the balance between carbon dioxide assimilation by planktonic photosynthesis and carbon dioxide release by respiration. Seasonal changes of calcium concentrations are balanced by chemically equivalent alkalinity changes, but magnesium concentrations do not fluctuate. Photosynthesis occurs in both the epilimnion and the metalimnion of a deeper, less productive lake. These are the only depths oversaturated with calcium carbonate during open-water season.
W69-00446

LIMNOLOGY, PRIMARY PRODUCTIVITY, AND CARBONATE SEDIMENTATION OF MINNESOTA LAKES,
Minnesota Univ.
Robert O. Megard.
Limnological Res Center, Interim Rep 1, Jan 1967. 69 p, 25 fig, 11 tab, 7 ref. OWRR Project A-008-Minn.

Descriptors: Sedimentation rates, *Eutrophication, *Lakes, *Primary productivity, *Plankton, Algae, *Photosynthesis, Productivity, Water quality, *Limnology, Minnesota, Water analysis, Calcium carbonate, Hypolimnion.

The report describes investigations of the regional limnology of Minn. The work has involved 3 phases: (1) a mobile laboratory was designed and outfitted; (2) standard field and laboratory methods were modified to make them more compatible with the mobility of the laboratory; and (3) a study was begun of the primary productivity and general limnology of 14 lakes in various parts of the state. The laboratory permits water samples to be analyzed at lakeside before nutrient concentrations are altered by biological activity and provides facilities for measuring the growth rates of algae and determining the fertility of lake water. The oxygen light-dark-bottle method is being used to compare algal productivity. The response of the carbonate saturometer in fresh water was tested, and the instrument was used to determine the degree of calcium carbonate saturation at different times of the year and at various depths in the lakes. The seasonal chemical changes in the lakes are described and the productivity data assembled, but there are not yet enough data for a detailed comparison of the lakes.
W69-00632

SURFACE-WATER CHEMISTRY OF SOME MINNESOTA LAKES, WITH PRELIMINARY NOTES ON DIATOMS,
Minnesota Univ., Minneapolis.
Robert C. Bright.
Limnological Res Center, Bell Museum Natur History, Univ Minn Interim Rep 3, Apr 1968. 51 fig, 44 ref, append, disc. OWRR Project B-001-Minn.

Descriptors: Bibliographies, *Minnesota, *Lakes, *Diatoms, *Algae, Ecology, South Dakota, Field investigations, Water pollution, Water sampling, *Water analysis, *Chemical analysis, pH, Sampling, On-site data collections, Limnology.

A comprehensive field study was made of diatom ecology in lakes of Minn and adjacent parts of South Dakota. The program consisted of 4 phases: (1) identification and determination of the geographic distribution and relative abundance of diatoms in the region, (2) correlation of diatom distribution and relative abundance with regional patterns of surface-water chemistry, (3) correlation of information from the first 2 phases with the composition of the diatom flora in surface sediments from each lake, and (4) application of conclusions from the first three parts to fossil diatom floras and paleoecology of lakes. Minnesota and adjacent South Dakota comprise the best area in North America for such a broad study because of the wide variety of lake types and their wide range of salinity. The ensuing discussions deal mainly with fall surface-water chemistry, possible origins of its regional pattern, its correlation with similar data from other areas, and its controlling factors.
W69-00659

2I. Water in Plants

GROUND WATER REGULATION IN THE COASTAL FLATWOODS OF MISSISSIPPI,
Mississippi State Univ., State College.
W. Frank Miller.
Water Resour Res Inst Rept July 1966. 10 p, 4 tab, 22 ref, disc. OWRR Project A-005-Miss.

Descriptors: *Groundwater, *Water management, *Mississippi, Coasts, Soil moisture, *Drainage, Pine trees, *Trees.
Identifiers: *Groundwater management.

This study was designed for evaluating water balance relationships of poorly drained Coastal Flatwoods soils and determining the feasibility of water regulation to increase production of slash pine (Pinus elliotti). These extensive, poorly drained areas which once supported longleaf pine (P. palustris), are now, through cutting practice and the advent of fire protection, primarily slash pine sites. Preliminary observations in the Flatwoods indicated that in addition to an excess of ground water during the initial portion of the growing season, there was a possibility of drought conditions which might limit the growth rate of the pine in the late spring and again in the late fall. The conclusion was reached that water table regulation of the studied soils is desirable.
W69-00635

THE WATER ECONOMY OF TURFGRASS,
Rhode Island Univ., Kingston, Coll of Agri.
Irene H. Stuckey.
Termination Rep, Coll Agr, Univ Rhode Island, 1967. 17 p, 14 fig. OWRR Project A-009-RI.

Descriptors: *Turf grasses, Grasses, Bluegrasses, Kentucky bluegrass, Turf, Field capacity, Soil moisture, Agriculture, Plant physiology, Irrigation effects, Moisture content, *Water requirements.

Replicated plots of Kentucky bluegrass were clipped at 3/4, 1-1/2, and 3 in. Soil moisture was measured by plaster of Paris blocks at 3 in. and at 8 in. Block 1 covered with an automatic rain shelter received 1 in. of water whenever the 3 in. level in the soil dropped below 50% in half of the plots. Block 2 received rain and additional irrigation on the same basis as Block 1. Block 3 received only rain. Less water was used by the 3/4 in. cut, but these plots were weedy and unattractive and subject to erosion. Moisture from lower levels influenced readings at the 3 in. depth since they would change abruptly when the moisture level at the 8 in. level changed.
W69-00663

2J. Erosion and Sedimentation

POLLEN AND DIATOMS IN SEDIMENTS OF A POST-PLEISTOCENE LAKE,
Iowa State Univ. of Science and Technology, Ames, Dep Bot Plant Pathol.
John D. Dodd, Ruth M. Webster, and Larry Wehr.

Proj Rep, Iowa State Univ Sci and Technol, Jan 1967. 9 p. OWRR Project A-008-Ia.

Descriptors: Cores, Glacial soils, Till, Carbon radioisotopes, Lake soils, *Diatoms, *Pollen, Palynology, Sediments, Marine microorganisms, *Lake beds, Aquatic animals.
Identifiers: Lake Okoboji, Iowa.

Preliminary analyses were made of a 35-ft core sample from post-glacial sediments in Miller's Bay, Lake Okboji, Iowa. A radiocarbon date of 12,700 plus or minus 200 yr for the bottom level was obtained. Comparative evaluations of diatoms and pollen have been initiated, the latter suggesting the expected transition from gymnosperm forest to mixed forest to prairie. Redeposited foraminifera, radiolarians, and coccoliths of Cretaceous origin were noted. In addition to pollen and diatoms, numerous plant and animal fragments were encountered in the sediments. These included Staurastrum (desmid), Rivularia (blue-green alga), Pediastrum (green alga), Chara zygotes, chrysophyte cysts, moss leaves, grass epidermis, bladderwort leaf hairs, insect larval mouth parts, cladoceran fragments, sponge spicules, bryozoan cysts, ostracod valves, snail shells, etc. Analyses of organic content suggested that wide fluctuations in this parameter were related to periods of environmental change.
W69-00404

EROSION FROM SUBURBAN HIGHWAY CONSTRUCTION,
U S Geological Survey.
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00423

DADE COUNTY, FLORIDA (BEACH EROSION CONTROL AND HURRICANE PROTECTION).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 335, 103 p, 1968. 16 fig, 1 plate, 9 tab, 1 suppl, 1 append.

Descriptors: *Beach erosion, *Shore protection, *Flood control, *Landfills, Hurricanes, Coastal engineering, Florida, Wave pile-up, Currents (Water).
Identifiers: Dade County, Florida, Miami Beach.

A beach erosion and hurricane protection study in Dade County, Florida, found that the most practical way to restore adequate recreational and protective beaches and to stabilize the shoreline is to artificially fill the beach and dunes between Government Cut and Baker's Haulover, and build a beach at Haulover Beach Park. The plan of improvement would involve placement of about 14, 800,000 cubic yards of fill. Periodic replenishment is necessary. Estimated first cost is $29,500,000 and annual cost is $488,000. Hurricane frequency, hurricane tide data, flood damage, and costs are tabulated. Maps show plan of improvement, hurricane paths, tides and high water profiles. (Knapp-USGS)
W69-00441

EROSION OF COHESIVE SEDIMENTS,
Bureau of Reclamation, Denver, Colo.
Phillip F. Enger, Ernest T. Smerdon, and Frank D. Masch.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY4, pp 1017-1049, July 1968. 33 p, 21 fig, 6 tab, 64 ref, append.

Descriptors: Agriculture, Channels, *Cohesive soils, Design criteria, *Erosion, Field investigations, Hydraulic laboratories, Sedimentation, Hydraulics, Sediment control, *Sediments, Bibliographies, *Soil erosion, Deposition, Soil physical properties, Tractive forces, Boundary shear, Scour, Stable channels.
Identifiers: Sediment load, Sediment deposits, Bank stability, Critical tractive force.

This final report describes laboratory research, field observations, design criteria, and agricultural land and channel problems relating to cohesive sediments. Laboratory research has been directed toward determining relationships between a critical boundary shear stress or a tractive force above which scour of a cohesive material begins, pertinent soil properties, and flow conditions. Erosion or deposition occurring in a natural water channel depends on the local forces exerted by flowing water, geology and properties of the material over which the water flows, and sediment load being transported. Current literature is reviewed and recommendations are made for practical design application and future research. An extensive bibliography, a compilation of design equations and charts, and design information not available in the literature are included. (USBR)
W69-00608

VELOCITY AND SEDIMENT CONCENTRATION DISTRIBUTIONS IN OPEN CHANNEL FLOWS,
South Dakota State Univ., Brookings.
B. E. Eno.
Report to OWRR Project A-007-SDak, June 1968. 7 p.

Descriptors: *Open channel flow, Flow characteristics, Flow profiles, *Velocity, Transition flow, Turbulent flow, Theoretical analysis, Sediment transport, *Sediment distribution, Instrumentation, Continuity equation, Momentum equation, *Channel morphology, Boundary layer, Roughness coefficient.

Turbulent velocity distributions in open channel flows were analytically reviewed and experimentally investigated. The works of Prandtl, Von Karman, and Nikuradse pertaining to turbulent velocity distributions were critically reviewed with a view toward particular application to open channel flows. Physical and mathematical inadequacies of these works were noted and discussed. The experimental phase consisted of velocity distribution measurement in smooth and artificially rough channels. The roughness elements included lateral strips, cubes and hemispheres placed on the flume bed at various spacings in various patterns. An equivalent roughness parameter was devised and calculated for many of the roughness patterns. The experimental results were compared to the work of other authors and discussed. The suspended sediment transport theory was briefly reviewed, emphasizing its dependency upon a valid velocity distribution model.
W69-00675

GENERAL TWO-DIMENSIONAL STOCHASTIC MODEL FOR THE TRANSPORT AND DISPERSION OF BED-MATERIAL SEDIMENT PARTICLES,
U. S. Geological Survey, Colorado State University, Fort Collins, and Kansas State University, Manhattan.
William W. Sayre, and W. Jay Conover.
Proc of the 12th Congr, Int Ass for Hydraul Res, pp 88-95, Sept 1967. 8 p, 2 fig, 6 ref.

Descriptors: *Bed load, *Dispersion, *Sediment transport, *Statistical models, *Stochastic processes, Alluvial channels, Tracking techniques, Marking techniques, Sediments.
Identifiers: *Stochastic models.

The transport of bed-material sediment particles in an alluvial channel is represented as a stochastic process consisting of a sequence of longitudinal and vertical displacements of random magnitude between which there are rest periods of random duration. In order to apply the model, the probability density functions for (1) the step lengths, (2) the rest period durations given the elevation at which a particle is deposited, and (3) the elevation at which a particle is deposited, must be known. It is suggested that these functions be experimentally evaluated by tracing a single radioactive particle to evaluate length of steps and rest periods. (Knapp-USGS)
W69-00683

TOTAL BED-MATERIAL DISCHARGE IN ALLUVIAL CHANNELS,
Geological Survey, Washington, D. C., Water Resources Div., Colorado State University, Fort Collins.
Feng-Ming Chang, Daryl B. Simons, and Everett V. Richardson.
Proc of the 12th Congr, Int Ass for Hydraul Res, pp 132-139, Sept 1967. 8 p, 2 fig, 6 ref.

Descriptors: *Sediment transport, *Bed load, *Suspended load, *Alluvial channels, Flow rates, Particle size.
Identifiers: Prandtl equation, Reynolds equation, Bed-material discharge.

A study of total bed-material discharge in alluvial channels, partially based on existing theories, was conducted. The bedload discharge was obtained by utilizing the energy-work relation of the fluid and the bed material. An equation for velocity distribution was obtained by integrating the Reynolds equations using Prandtl's hypothesis of mixing length. Applying the basic equation for the distribution of suspended load by O'Brien, the suspended bed-material discharge was investigated in terms of bedload discharge. Then, the total bed-material discharge was obtained simply by adding the bedload discharge and the suspended bed-material discharge. The results through checking with available laboratory and field data appeared to be mutually consistent and satisfactory. (Knapp-USGS)
W69-00684

EFFECT OF NON-EQUILIBRIUM FLOW CONDITIONS ON SEDIMENT TRANSPORT AND BED ROUGHNESS IN A LABORATORY ALLUVIAL CHANNEL,
U S Geological Survey, Colorado State University, Fort Collins.
R. E. Rathbun, and H. P. Guy.
Proc of 12th Congr, Int Ass for Hydraul Res, pp 187-193, Sept 1967. 7 p, 2 fig, 4 ref.

Descriptors: *Sediment transport, *Flumes, *Sediment load, *Graded, *Model studies.
Identifiers: Nonequilibrium flume flow conditions.

Non-equilibrium flow conditions were examined in a laboratory alluvial channel to determine responses of the recirculation and sand-feed systems of flume operation to change in load, tailwater depth, and sand-bed slope. It was found that the simple proportionality suggested by Lane (1955) for relating sediment transport rate, sand size, water discharge and slope, predicted qualitatively the results. Experiments were limited to one water discharge and one sand. (Author)
W69-00685

2K. Chemical Processes

CO-OXIDATION OF ORGANIC MOLECULES BY METHANE-OXIDIZING BACTERIA GROWING AT THE EXPENSE OF METHANE,
Illinois Univ, Urbana.
R. E. Kalio.
Water Resour Center Res Rep 11, Univ Ill, July 1967. 5 p, 1 fig, 1 tab. OWRR Project A-016-Ill.

Descriptors: *Bacteria, *Methane, Benzenes, Aromatic compounds, *Oxidation, Enzymes, Methane bacteria, Pseudomonas.

Bacteria which oxidize methane are known to oxidize other substances while they are growing on methane. Tests were conducted on a large number of these bacteria to determine whether they could oxidize benzene-based organic compounds. None of the methane-oxidizing bacteria attacked benzene rings. Bacteria which attack benzene (or aromatic) rings contain an unusual enzyme called benzene hydroxylase which is not found in methane-oxidizing bacteria.
W69-00407

THERMODYNAMIC RELATIONSHIPS WITHIN THE SYSTEM: SEDIMENTS-SEA-AIR,
Massachusetts Univ, Amherst.
Oliver T. Zajicek.
OWRR Project A-012-Mass, Final Rep, Jan 1968. 11 p, 7 fig.

Descriptors: *Iron oxides, *Equilibrium, Chemical reactions, Vapor pressure, *Oxygen, Sea water, Atmosphere, pH, Electrochemistry, Solutions, Solubility, Aqueous solutions, Electrical conductance, Thermodynamics, Thermodynamic behavior.

This project attempts to add to our knowledge of a chemical equilibrium thought to obtain at the hydrosphere-atmosphere interface, namely, the interaction of iron oxides with molecular oxygen, thought possible to be the buffering equilibrium for the oxygen content of the atmosphere. The question arises as to whether the partial pressure of oxygen is still increasing or whether it is fixed at its present value of 0.21-atm. Conductivity and pH measurements have been carried out on solutions of ferric nitrate in chloride-nitrate mixed media. The pH range, electrolyte concentration, and composition of salt media have been varied. Eleven solvent solutions were used in which the ionic mole ratio was varied from 0 to 1. In these solutions the total electrolyte concentration was held constant at 0.5, 1.5, 2.5, and 3.5 mole/1. Because of the termination of the project, results to date are incomplete and positive conclusions cannot be drawn from the data. However, certain anomalous trends were observed in which conductivity increased while pH decreased, suggesting the possibility of a polymeric hydrolyzed iron species in which the adsorbed hydrogen ions are thermodynamically stable yet kinetically liable.
W69-00415

ISOTOPIC ANALYSIS OF URANIUM IN NATURAL WATERS BY ALPHA SPECTROMETRY,
U S Geological Survey, Water Resources Division.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00425

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-II. INFLUENCE OF HYDRONIUM ION CONCENTRATION ON ABSORPTIVITY,
Rutgers Univ., New Brunswick, N. J.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00622

2L. Estuaries

THE NET EFFECT OF WIND ON TIDAL STREAMS IN FLORIDA,
Florida Univ, Gainesville.
David H. Moreau.
Water Resour Res Proj Completion Rep, Oct 1967. 11 p, 1 fig, 5 tab, 5 ref. OWRR Project A-006-Fla.

Descriptors: *Wind tides, *Winds, Wind velocity, Waves, Regression analysis, Estuaries, Florida, Time series analysis, *Tides.

The object of this study was to determine the effect of wind velocities on tide heights in a small Floridian estuary. In particular, the task was to perform a statistical analysis of wind and tide data collected during a one-year period at Cedar Key, Florida. Astronomical tides were extracted from the data using a harmonic function for the nine most significant components from a total of twenty-six as reported by USC and GS. Coefficients were estimated using a least-squares analysis. Astronomical tides accounted for 87% variance in the record. Hourly deviations of observed data from estimated astronomical tides averaged-0.027 feet with a standard deviation of 0.705 feet. Those deviations were then related to components of wind velocity taken perpendicular and parellel to the shore line using linear regression analysis. Averaging of the instantaneous wind velocities at a given hour with those in the preceding hour produced the best correlations, but this combination explained only 25% of the residual variance. Several factors were noted that limited the correlation: (1) data were available at a single station, (2) all data were instantaneous readings, and (3) the analysis was based on all wind observations with no attempt to select only those data corresponding to higher winds.
W69-00409

PROCEEDINGS SYMPOSIUM ON ESTUARINE ECOLOGY COASTAL WATERS OF NORTH CAROLINA.
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.

May 1966. 111 p, 1 fig, 9 tab, 17 ref. OWRR Proj A-999-NC.

Descriptors: *Estuaries, *Estuarine environment, *Estuarine fisheries, *Ecology, *Ecosystems, State governments, Federal Government, North Carolina.

This Proceedings of a Symposium on Estuarine Ecology of the Coastal Waters of North Carolina includes papers describing the estuarine research and action programs of the N. C. Departments of Conservation and Development, Water and Air Resources, and Health; N. C. Wildlife Resources Commission and State Recreation Commission; and the U. S. Fish and Wildlife Service, National Park Service, Public Health Service; the University of North Carolina at Chapel Hill and North Carolina State University at Raleigh.
W69-00460

DYNAMIC AND STATIC STUDIES OF SEA-WATER INTRUSION,
Hawaii Univ., Honolulu.
L. Stephen Lau.
Water Resour Res Center, Univ Hawaii, Tech Rep No 3, Feb 1967. 31 p, 9 fig, 20 ref, 4 append. OWRR Project A-007-Hi.

Descriptors: Saline water intrusion, Hawaii, Ground water, Basalts, Aquifers, Density stratification, Ground water, Saline water-freshwater interfaces.
Identifiers: Ground water discharge, Density diffusion, Ground water dispersion, Ghyben-Herzberg principle.

A theoretical equation was adapted and modified for a water table aquifer to relate fresh water flow to the sea, geometry of the fresh water-sea water interface, and aquifer characteristics under dynamic equilibrium. Verification was obtained in laboratory experiments conducted in a hydraulic sand model. Other laboratory experiments revealed special flow patterns in the transitional zone of the fresh water-sea water interface. The extent and the vertical density gradient of the brackish water in the transitional zone were examined for their effects on modifying the conventional Ghyben-Herzberg ratio. Groundwater data collected from a deep well on Oahu, Hawaii, was discussed as an illustration.
W69-00618

SALT-WATER INTRUSION EFFECT OF A FRESH-WATER CANAL,
Georgia Inst. of Tech., Atlanta, Civil Eng. Sch.
M. R. Carstens, and George D. May.
Water Resour Center, Ga Inst Tech, May 1967. 49 p, 6 fig, 6 tab, 5 ref, 1 append. OWRR Project B-003-Ga.

Descriptors: *Aquifers, *Seepage, Flow, *Groundwater movement, Soil water movement, Canals, *Saline-fresh water interfaces, *Groundwater barriers, *Saline water intrusion, Permeability, Water table, Flood plains, Pore pressure, Land reclamation, Flownets, Silts, Saturated flow, Saturated soils, Subsurface flow, Laplaces equation.
Identifiers: Chauchy-Riemann equation.

The effectiveness of a fresh-water canal to act as a barrier to salt-water intrusion in areas adjacent to salt-water bodies is analyzed and discussed. Results for a condition in which the fresh-water seepage from the land is a small fraction of the fresh-water seepage from the canal are presented. Solutions discussed show that the fresh-water flow from a canal acts as a dam forcing to a lower elevation the interface between the salt-water saturated soil and the fresh-water saturated soil. Laplace's equation in the fresh-water flow domain is solved for the flow condition which involves a water table and a second density interface between the fresh water and salt water. Seepage losses from a fresh-water canal with fine-grained soils were not found to be excessive. Use of a fresh-water canal for reclamation of salt-water intruded deltas for agricultural purposes are discussed.
W69-00667

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

YIELD OF STREAMS IN MASSACHUSETTS,
Massachusetts Univ, Amherst.
G. R. Higgins.
OWRR Project A-003-Mass, Water Resour Res Center, Univ Massachusetts, Interim Rep, Mar 1967. 175 p, 14 fig, 4 tab, 13 ref, 4 append.

Descriptors: *Water yield, *Storage, *Hydrology, Mass curves, *Streams, Frequency, Flow, Evaporation, Droughts, Drainage basins, Massachusetts.

It is specifically the purpose of this project to provide a practical guide whereby preliminary values of storage required to sustain a desired yield from any drainage basin in the Commonwealth of Massachusetts can be easily predicted. Mass curves, recurrence interval curves, and flow duration curves for nearly all the gaged streams in Massachusetts are presented together with a discussion of the water resource problems of the Commonwealth. Results from the mass curves are expressed in the form of frequency curves which reflect all the streamflow data available through the drought year of 1965. In order to estimate the effect of creation of reservoirs on yield, the current research efforts are concerned with an evaporation study on the Quabbin Reservoir. In subsequent reports it is recommended that these data be incorporated along with a full assessment of the drought. The present report is labeled INTERIM pending the further study and application of computer methods to working up the data.
W69-00411

SMALL WATERSHED STORAGE INCREASE USING LOW DAMS,
Massachusetts Univ, Amherst.
Karl N. Hendrickson.
OWRR Project A-016-Mass, Water Res Center, Invest Rep, Jan 1967. 20 p, 8 ref.

Descriptors: Groundwater, Hydrographs, Infiltration, Rainfall, Runoff, *Water yield improvement, Hydrology, Research and development, *Small watersheds, Retention, Evaptranspiration, Hydrologic budget, Water storage, Benefit-cost ratios, Dams.
Identifiers: Base flow, *Low dams, *Retention dams.

Information generated by experimental watersheds, hydrology investigations, and new statistical methods is so great and sophisticated that only large projects can afford to exploit it properly. Great areas of the country are made up of town and city-owned small watersheds not producing all the water that they could because of underdevelopment of ground water capacity for charging. Low

dams reduce runoff and provide a longer period for infiltration. This increases duration and amount of base flow. A simple, rational method of appraising, designing, and estimating the value of low dams is presented. The scheme consists of estimating base flow, infiltration capacity, and evaporation from a short summer rainfall by observing the amount and duration of the rain, runoff of the stream and change of the water table. From this data, probable change as the result of construction of a low dam is estimated. Change is related to the domestic price of water and its probable value to the system to determine project economy. A case study is used to illustrate the method.
W69-00417

WATER RIGHTS LITIGATION,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00521

LEGAL ASPECTS OF WEATHER MODIFICATION-SNOWPACK AUGMENTATION IN WYOMING,
Wyoming Univ, Laramie.
John M. Pierce.
Water Resour Ser No 11, Univ Wyoming, Laramie, June 1968. 59 p, suppl, 236 ref.

Descriptors: Atmospheric precipitation, *Weather modification, *Laws, Weather, Cloud seeding, Riparian rights, Liabilities, Bibliographies, Natural resources, Agreements, Claims, Damages.
Identifiers: Snow pack, Atmospheric research, *Legal aspects, USBR Research Contracts, *Legislation, Wyoming, Ownership, Snowfall.

At the present time the legal aspects of weather modification are undefined. Few cases have been decided and there is no legal consensus of either the control and ownership of clouds and the moisture therein or of the liability of the weather modifier. Twenty two states have enacted legislation regulating weather modification activities; most statutes amount to no more than token regulation. The need for Federal regulation of weather modification has been expressed in the Congress. If states continue to make no more than token regulations, pressure will force the Federal government to take over all facets of weather modification. Most theories advanced for determining ownership of clouds and moisture therein are based on rules and theories used in other areas of natural resources. Little new thinking has developed with consequent little attempt being made to adjust legal thinking in scientific areas. Unless new ideas are presented and adlpted by the legislatures and courts, the legal profession will have failed in its obligation to society. Now is the time for legal institutions to act so that development can take place independent of pressures, and proper recognition can be given to social and economic effects that my result. (USBR)
W69-00612

STORAGE REQUIREMENTS FOR WATER IN THE UNITED STATES,
Resources for the Future, and U S Geological Survey, Washington, D. C.
George O. G. Lof, and Clayton H. Hardison.
Water Resources Res, Vol 2, No 3, pp 323-354, 1966. 32 p, 6 fig, 11 tab, 9 ref.

Descriptors: *Water storage, *Reservoir storage, *Regulated flow, *Dams, *Cost analysis, Routing, Water management (Applied), Evaporation.
Identifiers: Water storage requirements.

Storage requirements for various levels of streamflow regulation in the 22 major regions of the contiguous U S are presented to supersede those given in Committee Print 32 of the Select Committee on National Water Resources, U S Senate. At levels of development, the storage required to provide the desired flow in 95 and 98% of the years is substantially larger than that previously given. Carry-over storage requirements based on probability routing of annual discharge are combined with seasonal storage requirements to give the revised storage requirements, which are then used to compute revised evaporation losses and revised cost estimates by the methods previously used. The maximum net flow that could be made available for the 22 regions for 98% of the years is shown to be 965 billion gal per day (bgd) for which a storage capacity of 3.6 billion acre-ft would be required. A net flow of 922 bgd could be made available with 2 billion acre-ft of storage. Any increment of flow above the 922 bgd figure would have storage costs exceeding 10 cents per thousand gal delivered. (Knapp-USGS)
W69-00696

3E. Conservation in Industry

THE AVAILABILITY OF WATER FOR INDUSTRIAL USES IN SELECTED SMALL COMMUNITIES IN MISSISSIPPI,
Mississippi State Univ., State College.
Guy T. Peden, Jr., and Van N. Oliphant.
Water Resour Res Inst Rep, June 1967. 101 p, 4 fig, 16 tab. OWRR Project A-011-Miss.

Descriptors: Bibliographies, Water, Industries, Rural areas, Water requirements, *Industrial water, Mississippi, *Water supply, Social aspects, Rainfall, Groundwater, Aquifers, Water wells.

This study was undertaken to determine availability of water for industrial uses in selected small communities in Mississippi. Results show that water is available for industrial uses in these communities. Several communities did not have all of the water information requested. Ground water is the source of supply for all communities in the study. Aquifers servicing these communities yield continuing supplies of excellent to good quality water. None of the communities foresees any problem in its future water supply. The majority of the communities have excess capacities which can supply relatively large amounts of water. Increasing demands by industrial, residential, and commercial users may force these communities to expand their facilities. The majority of the industries in the area depend on community facilities for water supply. Several industries and the largest individual users have privately owned industrial wells. Industries in the study area use water in quantities ranging from several hundred gallons per month to over 40 million gallons per month. The majority of the industries in the study area stated that they did not locate at their present location primarily because of available water.
W69-00633

WATER: AS A FACTOR TO ATTRACT INDUSTRIES,
Ministry of Agriculture, Ankara, Turkey.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00650

3F. Conservation in Agriculture

DEVELOPMENT OF METHODS FOR INCREASING THE EFFICIENCY OF WATER USE IN CRANBERRIES,
Massachusetts Univ, Amherst.
John S. Norton.
OWRR Project A-005-Mass, Pap, Symp Water Resour Res, Univ Massachusetts, June 1967. 16 p, 15 fig, 1 tab.

Descriptors: *Cranberries, *Dikes, Irrigation systems, Irrigation efficiency, *Flood irrigation, *Water harvesting, Bogs, Equipment.

Materials were procured for an assortment of temporary dikes for cranberry bogs and 7 dikes were built. Two dikes were vinyl sheeting supported on railings and anchored below ground by 1 by 2 in. wood strips. One dike was aluminum, supported by a wood railing. Three dikes were earth with sheet aluminum cores. Two of the earthen dikes were built over filled-in ditches, the third built on bog surface. The seventh dike was erected on private property but removed prior to testing. Only the sheet vinyl and aluminum dikes were constructed in time for testing in 1966. Considerable difficulty was experienced because of washouts under both the vinyl and aluminum sheeting. Tests will be made on all dikes in 1967 in conjunction with work under Hatch Project No 51. The current trend toward water harvest methods. The equipment consists of an elevator to remove the berries from the water surface, and a blower, ducting, and screen to separate debris from the berries before they are loaded into trucks.
W69-00412

THE DISTRIBUTION AND PERSISTENCE OF DIAZINON APPLIED TO PLANT AND SOIL AND ITS INFLUENCE ON RHIZOSPHERE AND SOIL MICROFLORA,
Institute of Agricultural and Industrial Microbiology, Amherst and the Cranberry Experiment Station, East Wareham, Mass.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00414

PHYSICAL AND ECONOMICAL ASPECTS OF CONJUNCTIVE USE OF IRRIGATION WATER IN SMITH VALLEY, LYON COUNTY, NEVADA,
Nevada Univ., Reno, Desert Res. Inst.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00466

WATER CONSERVATION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00502

FACILITIES FOR WATER STORAGE AND UTILIZATION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00503

WATER CONSERVATION AND UTILIZATION PROJECTS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00504

HYDRAULICALLY CONTROLLED BUTTERFLY GATES IN FARM LATERAL TURNOUTS FOR AUTOMATION OF SURFACE IRRIGATION SYSTEMS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-00588

AGRICULTURAL WATER CONSIDERATIONS IN DEVELOPING STATE WATER PLANS,
Texas A and M Univ., College Station.
Fred A. Schmer, and Carroll W. Keese.
Water Resour Inst Rep, 1966. 13 p, 5 fig, 1 tab.

Descriptors: *Agriculture, *Water development, Water costs, Economics, Irrigation, Water requirements, Water users, Crops, Water resources, Texas, Water utilization, Water resources development.
Identifiers: *Water plans.

Agriculture presently accounts for one-third or more of the total water use depending on how we define use. If we define use as making water completely unavailable for other uses, agriculture accounts for a higher portion of the water used. Some estimate that 85% of withdrawal can be at-

tributed to agriculture. Therefore, water for agriculture is of utmost concern in developing a water plan. Agricultural use is defined in this paper as water used for irrigation. In the analysis of agricultural resources related to water development in Texas an attempt was made to present to water planners the effect of unlimited water availability to agriculture and the effect of water being available to agriculture at a relative cost similar to that at the present time. Agriculture in Texas, and most other areas, cannot compete for water simply on the basis of need for agricultural production. Efficiency of this production and effect of irrigation and related industry on the total economy must be analysed if additional water is to be allocated to agriculture in the future.
W69-00607

COSTS AND RETURNS FROM CROPS AND LIVESTOCK IN THE UPLAND DESERT VALLEYS OF NEVADA,
Nevada Univ., Reno.
LeRoy F. Rogers, and William V. Neely.
OWRR Project-A-011-Nev. Desert Res Inst Prog Rep No 2, 58 p, 1 fig, 30 tab, 5 ref, append.

Descriptors: Land, Agriculture, *Land development, Land use, Land appraisal, Land management, *Cultivated lands, *Farm management, Costs, Economics, Ranges, Livestock, Forage palatability, Crops, Nevada, Arid lands, *Deserts, Valleys.

Data on selected crop and livestock enterprises are presented to aid current and prospective operators in planning desert valley development in Nevada. The report covers costs for clearing, tillage, water, fencing, crop development, and social and community development. Enterprise budgets were developed for Diamond Valley, Orovado District, Middle Reese Valley, and Antelope Valley.
W69-00638

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1960. (Parts 3 and 4. Ohio River Basin and St. Lawrence River Basin).
U S Geological Survey.

U S Geol Surv Water-Supply Pap 1742, pp 1-309, 1968. 309 p, 1 fig, 79 ref.

Descriptors: *Data collections, *Water quality, *Surface waters, *Ohio River, *St. Lawrence River.
Identifiers: Ohio River Basin, St. Lawrence River Basin.

Records of chemical analysis, suspended sediment, and temperature are compiled for waters of the Ohio and St. Lawrence River Basins for 1960. The data collected at the 136 stations on 78 streams include chemical analysis reports on silica, Fe, Ca, Mg, Na, K, carbonate, bicarbonate, sulfate, C1, F, nitrate, B, pH, total dissolved solids, specific conductance, discharge, suspended sediment load, and particle size analyses. Al, Mn, color, acidity, oxygen consumed, phenolic material, and minor elements are reported for a few streams. (Knapp-USGS)
W69-00431

MAP INTERPRETATION AND CLASSIFICATION OF BURIED VALLEYS,
Massachusetts Univ, Amherst.
Marvin Saines.
Ground Water, Vol 6, No 4, pp 32-37, July-Aug 1968. 6 p, 5 fig, 13 ref.

Descriptors: *Terrain analysis, *Valleys, *Glacial drift, Water sources, Superimposed drainage, Topography, Maps.
Identifiers: *Map interpretation, *Buried valleys, Deranged drainage.

Types of buried valleys are described and four examples are given of topographic map interpretation as related to water resources studies and the development of groundwater supplies. Buried valleys are the source of about 80% of the water pumped from glaciated areas in Ohio and other states. The two main types are: (Type I) valley completely buried by glacial drift without present streams along their courses, and (Type II) valleys that are partly buried or partly exhumed usually with streams along their courses. If a stream is flowing mainly in a Type II valley, the bottom of which is deeply buried by drift, local areas where the stream is cutting bedrock are postglacial channels of derangement. Postglacial channels of derangement, which often can be recognized on a topographic map, reveal that a buried valley (often Type I) exists nearby. (Knapp-USGS)
W69-00437

FALL WATER SUPPLY SUMMARY FOR NEVADA,
Dept of Agriculture, Soil Conservation Service, Reno, Nevada.
Bob L. Whaley, and Roy E. Malsor, Jr.
Soil Conserv Serv Water Supply Rep, Oct 1, 1968. 5 p, 4 tab.

Descriptors: *Water supply, *Forecasting, Groundwater, Streamflow, Reservoir storage, Snowmelt, Nevada, Soil moisture.

As forecast, extremely low streamflow has been experienced throughout Nevada this past season. In most areas, the streams peaked 2 to 3 weeks earlier than normal, and the flows likewise fell off much earlier than usual. Water users served from reservoirs have had a fairly adequate water supply, due to last year's good reservoir carryover. The heavy reservoir usage to augment the low streamflow left below-average amounts of water in storage in most of the reservoirs throughout the state. Streamflow ranged from a low of 9 to 19% on the Owyhee up to 73% on the Upper Carson River. The Humboldt River flowed less than 50% of average for the season. Above-normal June precipitation on the Humboldt added materially to the runoff this yr. Fall soil moisture surveys indicate that the mountain soils on the east slope of the Sierras are extremely dry. Soils in the Humboldt and Owyhee Basins are near average, however. This dry condition, coupled with the depleted reservoir storage, indicates the need for a normal or above normal snowpack this coming winter season in order to insure an adequate water supply next season. Tables and graphs show streamflow, reservoir storage, and soil moisture as of Oct 1, 1968. (Knapp-USGS)
W69-00439

STATE ROAD AND EBNER COULEES, WISCONSIN.
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 360, 57 p, 1968. 3 plate, 6 tab, 1 attach, 1 append.

Descriptors: *Flood control, *Channel improvement, *Diversion, Wisconsin, Cost-benefit analysis, Diversion structures, Relocation, Community development, Urbanization.
Identifiers: LaCross, Wisconsin, Urban developments.

Floods on State Road and Ebner Coulees, LaCrosse, Wisconsin were studied and control measures are suggested. The floods are caused by high rates of runoff from rugged terrain in upper reaches of the watersheds. Predicted damages are $351,700 in 1970 and $578,000 in 2020 without control. The suggested plan includes channel improvements and diversion works leading from Ebner Coulee to the LaCrosse River. The estimated first cost is $4,495,000 and annual costs are $192,000. The benefit-cost ratio is 1.36. (Knapp-USGS)
W69-00440

NAVASOTA RIVER WATERSHED, TEXAS (BASIN DEVELOPMENT STUDY REPORT).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 341, 252 p, 1968. 16 fig, 2 plate, 64 tab, 3 append.

Descriptors: *Flood control, *Water supply, *Recreation facilities, *Reservoirs, Texas, Channel improvement, Cost-benefit analysis, Water demand, Water yield, Hydrogeology, Aquifers, Surface waters.
Identifiers: *Navasota River Basin, Brazos River Basin.

A study of the Navasota River watershed, Texas, was made and it was decided that the authorized water supply and flood control project for Brazos River and Tributaries, Texas, be modified to provide for the construction of Millican and Navasota no. 2 Reservoirs with channel improvements or flowing easements, instead of the authorized Ferguson River Project. The estimated first cost is $119,707,000, the annual cost is $229,000 and the benefit-cost ratio is 2.8. The present water use in the Lower Brazos Basin is 340 mgd and is expected to increase to 1,326 mgd in 2025 and 2,088 mgd in 2075. Present supplies will be inadequate by 1980, requiring development of Navasota River water supplies. Irrigation and power projects are not included because they would yield less benefit than costs. Detailed hydrologic, water resources, and economic data are tabulated. (Knapp-USGS)
W69-00442

ALABAMA GREAT SOUTHERN RR CO V BROACH (SURFACE RUNOFF - PROOF AND DAMAGES).

119 So 2d 923-925 (Miss 1960).

Descriptors: *Judicial decisions, Mississippi, *Surface runoff, Surface drainage, *Landfills, Boundaries (Property), Rainfall, Damages, Legal aspects, Water law.
Identifiers: Damages (Legal aspects).

Plaintiff sought damages from the defendant railroad company, due to the alleged discharge of surface waters on plaintiff's property. Plaintiff alleged that this discharge was due to the railroad's filling of its land and the slight encroachment of this fill on plaintiff's land. At trial the railroad admitted such encroachment, which occurred because plaintiff had set his fence back several feet from the property line. However, the railroad did dispute the allegation that the fill materially increased the flow of surface waters onto plaintiff's land. The trial court directed a verdict for plaintiff, submitting on the issue of damages to the jury, with a very general instruction. On appeal to the Mississippi Supreme Court the case was reversed and remanded. The court held: (1) a verdict may not be directed where only one of two issues in the case was established without dispute; and (2) that an instruction on damages not furnishing the jury with any guide with reference to the rules of measurement of damages in surface water cases was in error. (R. F. Williams-Fla)
W69-00473

HAMMONS V ILLINOIS CENTRAL R R (SURFACE RUNOFF--FLASH FLOODS).

119 So 2d 846-848 (La 1960).

Descriptors: *Judicial decisions, Louisiana, *Surface runoff, Surface drainage, Ditches, Drains, Culverts, *Flash floods, Flood damage, Excessive precipitation, Obstruction to flow.

Plaintiff sued the railroad for property damage caused by flooding allegedly due to the blocking of the natural drainage from plaintiff's land by the railroad's roadbed. Plaintiff also contended that defendant's failure to construct a drain under its roadbed, and its improper construction of a drainage ditch along its right of way contrary to the grade, caused his damage. Defendant denied these allegations and averred that the drainage ditch was built by public authorities and not the railroad. The trial court found that the flood damage was due to a heavy rain and flashflood which was of the type to occur 'once in a decade,' and that the drainage ditch along the roadbed was built in collaboration with public officials, for the town's interests, not those of the railroad. Accordingly, the trial court found for the defendant. On appeal, the Louisiana Supreme Court affirmed the decision. Due to the unusual nature of the rain, plaintiff failed to prove negligence. He also failed to prove his loss was a result of defendant's commission or omission. (R. F. Williams-Fla)
W69-00474

BURSON V SALIBA (SURFACE RUNOFF IN ALABAMA).
116 So 2d 609-610 (Ala 1960).

Descriptors: *Judicial decisions, Alabama, *Repulsion (Legal aspects), *Surface runoff, Surface drainage, Obstruction to flow, Rainfall, Ditches.

Plaintiff Burson, owner of an upper lot in a municipality, sought a mandatory injunction and damages against Saliba, the adjoining lower landowner. Plaintiff sought to require defendant to remove a retaining wall and part of a building which it had built at the property line, and which allegedly blocked the natural flow of surface water from plaintiff's to defendant's land, thereby causing flooding conditions. Defendant's demurrer was sustained and plaintiff appealed. The Alabama Supreme Court held that the demurrer was properly sustained. The defendant breached no duty to plaintiff, and therefore there was no actionable negligence. A lower proprietor in an incorporated town or city can obstruct the flow of surface water from higher ground over his property even though it is the only way such water may pass. The sole reason for this is because the property happens to be in an incorporated area. Also, rainfall in a drainage ditch is not accorded the same rights as a defined, distinct stream. (R. F. Williams-Fla)
W69-00479

MONTGOMERY V DOWNEY (SURFACE DRAINAGE).
162 N E 2d 6-12 (1959); 17 111 2d 451.

Descriptors: Drainage water, Floodwater, *Return flow, Riparian waters, *Surface drainage, *Natural flow doctrine, Surface waters, Downstream, Upstream, Flow, *Levees, *Channels, Retaining walls, Judicial decisions, Illinois, Surface runoff, Prescriptive rights, Water law.
Identifiers: Dominant estate, Servient estate, Easements of drainage.

Suit to compel defendants to remove alleged obstructions to the natural flow of surface waters from adjoining lands of the plaintiff. It is alleged that certain work done by the defendants on a levee prevented sufficient drainage from plaintiff's dominant estate, and caused surface waters to back up and stand on plaintiff's land. The court held that once such an obstruction has been maintained for the prescriptive period, it may be said to have ripened into an easement and the owner of the servient estate then has the right to maintain the levee or obstruction at its original height and make such repairs as may be required to maintain it. However, in the absence of further expansion of the easement by prescription, the right to maintain does not permit raising the levee so as to cause damage to the land of the plaintiff. Plaintiffs failed to sustain the burden of proving injury to their land greater than that which the land had for many years sustained in times of flooding. The court thus found that the maintenance done by the defendants was within the permissive category. Judgment was rendered in form of the defendant. (Kuder-Fla)
W69-00482

JOHNSON V GOODVIEW (SURFACE DRAINAGE).

167 N E 2d 132-139 (Ohio Com Pl 1960).

Descriptors: Construction, Controlled drainage, Landscaping, *Drainage effects, Rainfall disposition, Return flow, *Surface drainage, *Surface runoff, Excess water, Rural areas, Cities, Reasonable use, Judicial decisions, Flow, Water law, Repulsion (Legal aspects), Ohio, Natural flow.
Identifiers: Civil law rule, Servient estate, Trespass.

Action by owner of lower city property against owner of higher city property for damages caused by the flow of surface water from higher to lower land. The court distinguished the urban from the rural law governing this situation. Under the urban rule, the owner of lower land is not bound to accept natural surface water flowing from adjoining higher land. There is no liability upon the lower owner if he raises the grade of his property in a reasonable manner, even though in so doing he obstructs the natural flow of surface water to back up and stand upon the higher land. Under the rural rule, however, the lower owner is bound to accept natural surface waters flowing from upper land with no liability on the part of the upper owner. The court points out, however, that there are several exceptions to this latter rule. Employing the urban rule, the court held that the defendant in constructing apartment houses and parking lots upon the higher land, and thereby increasing and diverting the flow of surface water upon the lower adjoining property, were liable for damages caused to the lower land. (Kuder-Fla)
W69-00483

KAZANAKY V BERGMAN (SURFACE RUNOFF).

17 Misc 2d 1015; 192 NYS 2d 302-304 (1959).

Descriptors: *Judicial decisions, New York, *Surface runoff, Surface waters, Surface drainage, Water injury, *Dams, Outlets, Pipes.
Identifiers: Evidence.

Plaintiff brought an action for injunctive relief and damages against defendant, who owned a contiguous tract of land with a higher elevation than that of plaintiff. Defendant had constructed a horseshow shaped dam which captured surface and perfolating waters from his land. Two pipes discharged any overflow which might occur, and these waters eventually found their way onto plaintiff's land. The dam did not leak nor did any water spill over the top. Plaintiff alleged that this was a diversion of surface water onto his land, causing a wet and marshy condition. The trial judge stated that in New York there is no discrimination between upper and lower proprietors, neither be dominant or servient to the other. Owners may improve their property, with only the limitation that they do so in good faith, and abstain from draining surface water onto their neighbor's property by pipes or ditches. Plaintiff failed to established a causal connection between the condition of his land and the pipes in defendant's dam. It appeared that such conditions resulted only from natural causes. Judgment was for defendant. (R. F. Williams-Fla)
W69-00490

DISCOVERY, DEVELOPMENT, AND MARKING OF WATER HOLES, ETC, BY GOVERNMENT.

43 USCA Secs 361-363.

Descriptors: *Arid lands, *Water holes, Locating, Sites, *Legislation, Public lands, Federal government, Fouling, *Water resources development, Appliances, Maps, Springs, Streams, Public benefits.
Identifiers: *Secretary of the Interior, Marking of water holes, Monuments, Signboards, Defacing of signposts, Crimes.

Section 361 empowers the Secretary of the Interior to: (1) discover, develop, and render more accessible for public benefit, springs, streams, and water holes on arid public lands of the United States; (2) erect and maintain signposts and monuments at intervals along the accustomed lines of travel, containing information and directions as to the location and nature of such water holes; (3) provide convenient means and appliances by which water may be brought to the earth's surface at the water holes; (4) prepare and distribute maps, reports, and general information relating to the water holes and their specific locations. Section 362 makes it a crime to willfully or maliciously injure, destroy, deface, or remove any of the signposts or monuments, or to willfully or maliciously fill up, render foul, or in any way destroy or impair the utility of the water holes. Section 363 authorizes the Secretary to make such regulations as may be necessary to effectuate the purposes of the act. (Smodish-Fla)
W69-00506

RIPARIAN RIGHTS AND DUTIES,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00513

MCGIBNEY V WAUCOMA YACHT CLUB INC (DOCKS - RIPARIAN LAND).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00514

RECENT DEVELOPMENTS IN RESOURCES AND UTILITIES LAW,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00517

FLOOD CONTROL REGULATIONS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00526

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00531

KNIGHT V CIARLONE (INTERFERENCE WITH LITTORAL RIGHTS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00535

RANDLE V CITY OF ROME (MUNICIPAL LIABILITY FOR STORM DRAINS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00537

FAIRCHILD V KRAEMER (PUBLIC RIGHTS IN TIDAL MARSHES).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00538

SMITH V PEOPLE (LANDS APPROPRIATED FOR STATE RESERVOIR).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00539

ESSOCK V TOWN OF COLD SPRING (DRAINAGE DITCH).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00543

OAKLAND CLUB V CITY OF SOUTH EUCLID (SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00545

EBERLE V GREENE (OBSTRUCTION OF SURFACE WATER FLOW).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00546

FURTEK V WEST DEER TOWNSHIP (SURFACE DRAINAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00550

RULES OF CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00565

OPTIMIZATION OF THE OPERATION OF A MULTIPLE-PURPOSE RESERVOIR BY DYNAMIC PROGRAMMING,
California Univ, Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00596

IN-SITU DETERMINATION OF AQUIFER PARAMETERS FOR USE IN THE DRAINAGE FUNCTIONS,
Utah State Univ, Logan.
S. Abdollah Jenab, Dean F. Peterson, and A. Alvin Bishop.
Pap 68-203, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 37 p, 12 fig, 14 tab, 6 ref.

Descriptors: *Ground water, *Groundwater flow, *Drainage, Mathematical analysis, Aquifers, Drainage systems, Hydraulic conductivity, Discharge coefficients, Thickness, Water table, Field tests, Seepage, Porosity, Specific yield.
Identifiers: In situ tests, Glover equation, Drainage yield, Drain spacing.

Important aquifer characteristics in drainage design are hydraulic conductivity, aquifer thickness, and specific yield. Hydraulic conductivity measured in the laboratory is not reliable for field use, aquifer thickness is very hard to measure, and specific yield is an elusive variable. Most authors assume specific yield to be constant; others contend that it changes with depth to water table. Experience shows that water table height calculated from laboratory data does not agree with observed values in the field. Field measurements of aquifer characteristics are desirable to predict true fluctuations of ground water. Two field methods (constant discharge and constant head) were evaluated for measuring in situ aquifer parameters. Parameters are determined with transient functions and may be used in drainage and drainage discharge functions for designing drainage systems. Examples are given for the design. (USBR)
W69-00602

GROUND WATER REGULATION IN THE COASTAL FLATWOODS OF MISSISSIPPI,
Mississippi State Univ., State College.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-00635

SEEPAGE FLOW THROUGH AN EARTH DAM,
Georgia Inst. of Tech., Atlanta, Civil Engineering Sch.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00665

SALT-WATER INTRUSION EFFECT OF A FRESH-WATER CANAL,
Georgia Inst. of Tech., Atlanta, Civil Eng. Sch.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00667

CONFLUENCE ANALYSES OF LAND SURFACES,
Wyoming Univ., Laramie, Eng. Coll.
For primary bibliographic entry see Field 06F.
For abstract, see .
W69-00671

MISSISSIPPI RIVER FROM CASSVILLE, WISCONSIN, TO MILE 300.
U S Army Corps of Engineers, Washington, D C.

U S 90th Congr, 2d Sess, House Doc No 348, 128 p, 1968. 7 plate, 13 tab, 1 attach, 1 append.

Descriptors: *Flood control, *Iowa, *Illinois, *Mississippi River, Levees, Drainage systems, Cost-benefit analysis.

Data on flooding in the upper Mississippi River Basin are reviewed and plans for flood protection of Clinton and Bettendorf, Iowa, and Fulton, East Moline, and Milan, Illinois, are presented. Flood protection plans for the 5 cities were found to be economically justifiable. The improvements recommended would consist of levees, floodwalls, interior drainage facilities, and remedial work on railroads, utilities, and other structures. Flood control cost is $9,200,000 with a 2.8 to 1 benefit-cost ratio in Clinton, Iowa, $4,470,000 and 1.1 to 1 in Fulton, Illinois, $2,150,000 and 2.1 to 1 in Bettendorf, Iowa, $4,270,000 and 1.4 to 1 in East Moline, Illinois, and $1,210,000 and 1.9 to 1 in Milan, Illinois. (Knapp-USGS)
W69-00689

PRELIMINARY ESTIMATES OF LOW-FLOW FREQUENCY INTERRELATIONS FOR UPSTATE NEW YORK STREAMS,
U S Geological Survey, Albany, New York, Water Resources Division.
Robert M. Beall.
U S Geol Surv Prof Pap 600-C, pp C196-C198, 1968. 3 p, 1 fig, 3 ref.

Descriptors: *Low flow, *Frequency analysis, Statistical methods, Hydrographs, Discharge (Water), Base flow, New York, Flow characteristics.
Identifiers: *Low-flow frequency, Upstate New York streams.

Reasonably accurate values of mean annual discharge and of the annual low flow having a recurrence interval of 2 years usually can be obtained from short-term secondary or partial-record station data by correlation with long-term station data. At 125 sites in or near upstate New York where more than 20 years of daily discharge data have been collected, these flow characteristics have been related to annual low flows with recurrence intervals of 10, 20, and 50 years. The relation is shown as a family of curves from which long-term return period discharge may be estimated within accuracy limits of about 1% of the mean annual flow. (Knapp-USGS)
W69-00693

4B. Groundwater Management

GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN AREA,
Michigan State Univ, East Lansing, Dept Agricultural Eng.
Samuel B. Romberger.
Water Resour Res Terminal Rep, Apr-June 1967. 19 p, 2 fig, 3 tab. OWRR Project B-007-Mich.

Descriptors: Geochemistry, *Groundwater, Michigan, Acidity, *Analysis, Soil chemistry, Mineralogy, Solubility.
Identifiers: Aquifer geochemistry.

The factors controlling the chemistry of ground water are presently being studied in the upper Grand River drainage basin in central Michigan. Representative subsurface water samples have been collected and analysed for sodium, potassium, calcium, magnesium, iron, chloride, and sulfate. The chemical nature of the water changes with respect to pH, and the concentration of bicarbonate and iron, as it is brought to the surface from the depth of sampling. Therefore, it is necessary to measure these immediately after sampling in the field in order to obtain values representative of the water at depth. Values for these three quantities obtained in sampling and analysis. Analytical procedures for use in the field and in the laboratory have been developed so that a large number of samples can be collected and analysed rapidly with good accuracy and precision. Standard titration methods are used for bicarbonate and chloride; colorimeter methods for iron in the field and for sulfate; spectrometric methods for sodium, potassium, calcium, magnesium, and iron in the laboratory; and the pH is measured using a standard field pH meter. The results will be compared with the chemistry of the aquifer material, and with the composition of soils and surface materials to determine the relationship between them.
W69-00421

REGIONAL GEOLOGY AND GROUNDWATER HYDROLOGY OF THE SAHIL AREA, TUNISIA,
U S Geological Survey.
L. C. Dutcher, and H. E. Thomas.
U S Geol Surv Water-Supply Pap 1757-G, pp G1-G53, 1968. 53 p, 3 fig, 4 plate, 25 ref.

Descriptors: *Geology, *Water resources, *Hydrogeology, *Groundwater, *Arid lands, Water wells, Hydrologic data, Aquifers, Water quality, Logging (Recording), Groundwater basins, Water sources.
Identifiers: Tunisia, Sahil Susah, Tunisia.

The regional geologic and hydrologic features of the Sahil Susah area, in central Tunisia are discussed. The area has poor water resources which may be inadequate for the existing population of 447,000. The region is arid, and most of the small amount of precipitation falls on the mountains. Runoff and evaporation are high so that very little water is recharged to the ground, and dissolved solids are high. Saline lakes and salt-filled depressions are common. The rocks of the area are complexly folded and faulted, dividing it into a large number of groundwater basins. Shallow wells yield water everywhere in the area, but much of it is too saline to use. Fine sand impairs performance of many of the wells drilled for the study. Water in deeper formations is fresh only in the parts of the area where height and relief have permitted flushing. Water in deeper rocks under the low steppes and coastal area is saline. Maps show geology, well locations, piezometric contours, areas of artesian flow, and extent of aquifers. (Knapp-USGS)
W69-00429

GROUND-WATER RESOURCES OF THE ACU VALLEY, RIO GRANDE DO NORTE, BRAZIL,
U S Geological Survey.
Harry G. Rodis, and Jonas Maria de Castro Araujo.

U S Geol Surv Water-Supply Pap 1663-C, pp C1-C34, 1968. 34 p, 2 fig, 1 plate, 4 tab, 14 ref.

Descriptors: *Groundwater movement, *Natural recharge, *Water quality, Evapotranspiration, Recirculated water, Aquifers.
Identifiers: *Acu Valley, *Rio Grande do Norte, *Brazil.

To determine the availability of groundwater in and around the Acu Valley, Brazil, inter-governmental research was conducted. Estimated natural recharge alone is probably 2 1/2 to 5 times as the water pumped from wells in 1964 and may be increased by water introduced from upstream by the river, or by water moving underground from other adjacent aquifers. Recirculation of water infiltrating the water table will gradually cause an increase in dissolved solids in the water. Ground water quality is generally good; dissolved minerals will not affect irrigation in the Valley for some time and quality is not likely to deteriorate because of the relatively rapid circulation and renewal of water in the aquifer. Evapotranspiration will also tend to increase dissolved substances in water, and salts in soil. Water from alluvium is generally potable and can be used for municipal water supplies and other purposes. Wells in the alluvium yield up to 30,000 l/hr. Considerable water is available from the Acu Sandstone and the Jandaira Limestone deposits, but it is highly mineralized and is not of acceptable quality for human consumption at some spots. (Laverias-USGS)
W69-00430

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH,
U S Geological Survey.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00432

DESIGN AND CONSTRUCTION OF A DUAL RECHARGE SYSTEM AT MINOT, NORTH DAKOTA,
U S Geological Survey, Bismarck, North Dakota.
Wayne A. Pettyjohn.
Ground Water, Vol 6, No 4, pp 4-8, July-Aug 1968. 5 p, 2 fig, 1 tab, 1 ref.

Descriptors: *Recharge, *Pit recharge, *Recharge wells, Surface-groundwater relationships, Cost-benefit analysis, Cost comparisons, Water conveyance.
Identifiers: *Dual recharge, Perforated pit recharge.

A groundwater recharge facility was constructed in 1965 and placed in operation to forestall an impending water shortage at Minot, North Dakota. The facility is unique in that the rate of recharge to a buried sand and gravel aquifer is augmented by perforating an overlying bed of clay using hydraulic connectors (gravel-filled bored holes) in conjunction with an open-pit excavation. The connectors were drilled by typical well-boring techniques and the open pit was excavated by common construction methods. The recharge technique made it possible to add about 4.5 million gallons per day of water to underground storage with a total capital investment of about $200,000. The alternative originally proposed was a 50-mile long pipeline to Garrison Reservoir, at a 1959 estimated cost of $12,000,000. The recharge technique employed at Minot should have wide application in the groundwater industry in areas where natural recharge to permeable deposits is impeded by overlying beds of low permeability. (Knapp-USGS)
W69-00433

THE RELATIONSHIP BETWEEN SPECIFIC CAPACITY AND AQUIFER TRANSMISSIBILITY IN THE HOUSTON AREA, TEXAS,
U S Geological Survey, Houston, Texas.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00435

ESTIMATING COST OF GROUND-WATER WITHDRAWAL FOR RIVER BASIN PLANNING,
U S Geological Survey, Water Resources Division.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-00436

PHYSICAL AND ECONOMICAL ASPECTS OF CONJUNCTIVE USE OF IRRIGATION WATER IN SMITH VALLEY, LYON COUNTY, NEVADA,
Nevada Univ., Reno, Desert Res. Inst.
P. A. Domenico, D. F. Schulke, and G. B. Maxey.

Hydrol Water Resour Publ 1, Tech Rep Series 2, July 1966. 47 p, 19 fig, 4 tab, 13 ref. OWRR Proj B-007-Nev.

Descriptors: Groundwater, *Conjunctive use, *Optimum development plans, *Supplemental irrigation, *Water management (Applied), Water costs, Consolidation, Surface-groundwater relationships, Optimization, Water utilization, Pumped storage, Water allocation (Policy), Water resources development, Surface waters, Water distribution (Applied).

Supplemental irrigation wells in Smith Valley are individually owned and operated and can be used in conjunction with surface water to irrigate about 6300 acres of land whereas an additional 8700 acres have surface water rights only. Ground water is now used only to the extent of deficiencies in surface water supplies and as a late season requirement during years of normal or above-normal flow, or about 2 out of every 5 yr based on historical deficiencies. Most conjunctive appropriators are now virtually assured of a full supply of irrigation water every season regardless of flow of West Walker River. On the basis of historic flow and well yield and assuming centralized or district operation of the well fields for the benefit of the entire valley, existing pumping facilities could provide about 93% assurance of a full supply of irrigation water for all appropriators in Smith Valley. Further, analysis based on returns from ranching and cost of supplemental pumping for various levels of demand, efficiency, and lift, indicates that more water could be pumped cheaper with existing wells if the operation were centralized instead of under individual control. One suggestion is that the operating water district purchase and operate wells as 'sole owner,' thus providing water for benefit of the entire area.
W69-00466

ARTIFICIAL RECHARGE AND ITS ROLE IN SCIENTIFIC WATER MANAGEMENT, WITH EMPHASIS ON LONG ISLAND, NEW YORK,
US Geological Survey, Albany and Mineola, N Y.
Gerald G. Parker, Philip Cohen, and Bruce L. Foxworthy.
Pap, Proc Ser No 4, Symp Amer Water Resour Ass, San Francisco, Calif, pp 193-213, Nov 1967. 21 p, 5 fig, 2 tab, 56 ref.

Descriptors: *Aquifers, *Ground water, *Groundwater recharge, Seepage, Water conservation, Water management, Water quality, Water development, Water resources, Water sources, Water storage, Salt water barriers, Sea water intrusion, Watersheds, Flood control, Recharge wells, Underground water storage, Basins, Permeability, Bibliographies.
Identifiers: San Joaquin Valley, Calif, Long Island, N Y, Israel.

Water resources development and comprehensive management are discussed with particular emphasis on ground-water reservoirs and artificial recharge to achieve optimum benefit from available water resources. Aquifers must be managed so that storage will be reduced during peak consumption and replenished by recharge during periods of surplus surface water. Artificial recharge practices can (1) capture and store excess water, (2) alleviate flooding, (3) improve water quality, (4) store cooling water or heat for industrial processes, and (5) build barriers to reduce salt-water encroachment. Advantages of ground-water reservoirs over conventional types are reduced costs, larger capacities, no evapotranspiration losses, and use of large aquifers as distribution systems. A review is given of advances, problems, and the scope of artificial recharge and related operations in Israel, Southern Calif, and the High Plains of Tex. Insight into the magnitude and value of some of these aquifer systems can be gained from consideration of the San Joaquin Valley, Calif. A discussion of ground-water recharge on Long Island, N Y, provides knowledge of artificial recharge in urban and suburban coastal areas. (USBR)
W69-00606

4C. Effects on Water OF Man's Non-Water Activities

EROSION FROM SUBURBAN HIGHWAY CONSTRUCTION,
U S Geological Survey.
Raymond B. Vice, George E. Ferguson, and Harold P. Guy.
ASCE Proc, J Hydraul Div, Vol 94, No Hyl, Pap 5742, pp 345-348, Jan 1968. 4 p, 1 tab.

Descriptors: *Erosion, *Accelerated erosion, *Road construction, *Sediment yield.
Identifiers: Erosion effects of roadwork.

The extent of erosion and transportation of earth materials exposed in highway work was studied in a 4.54 sq mi drainage basin in Fairfax County, Virginia, in 1961 and 1964. About 11% of the basin was disturbed. Sediment yield was measured by sampling at gaging stations for 88 storm events representing the overland runoff from 1961-64. The mean concentration of sediment in the flow increased as the flow in a storm increased. Sediment concentrations in midsummer flow were about double these of midwinter flow. Variability of concentration and yield was considerable, depending on exposure and remedial measures. About 179 acres of construction contributed 94% of the 37,000 tons transported from the basin during the 3.4 years of record. About 85% of the total sand eroded and 29% of the silt were redeposited in the basin and did not pass the sampling site. Precipitation was 13% below average; there would have been about 22% more erosion, or 139 tons per acre per year, with average precipitation. That is ten times normal cultivated-land erosion and five hundred times that of pasture or forest. (Knapp-USGS)
W69-00423

GARDNER V RICHMOND COUNTY (INNUNDATION OF PRIVATE LANDS).

101 Ga App 261 113 S E 2d 411-412 (Ct App 1960).

Descriptors: *Floods, Georgia, *Compensation, Legal aspects, State government, Legislation.

The action was to recover damages to the plaintiff's property caused by flooding and ponding of water on his property due to certain acts of the Highway Department in improving a road. The trial court sustained demurrers to the petition because it was served on the Highway Department rather than the county. The court held that the plaintiff had a right under the constitutional provision requiring adequate compensation for property taken or damaged for a public purpose and that Ga Code no. 95-1710 provides a method for bringing suit against the state. The plaintiff's petition was correct and the demurrer should have been denied. (Horner-Fla)
W69-00480

KELLER V STATE (LIABILITY FOR FLOODING).
19 Misc 2d 794; 194 NYS 2d 358-366 (1959).

Descriptors: New York, Damages, Civil law, Community development, Eminent domain, Judicial decisions, Natural flow doctrine, Right-of-way, State governments, Water law, *Flood damage, *Negligent inundation, Overflow, Flooding, Culverts, *Embankments, Roadbanks, Highway drainage.

The defendant constructed a fourteen-foot embankment along its highway right-of-way that of necessity cut across the natural drainage of many lands, and caused flooding thereon. To remedy this situation, defendant then installed a culvert. The culvert did not alleviate the problem because it was installed in a negligent manner. The court held that recovery could be had by a landowner for damage resulting from public improvements effected under legislative authority if the damage is shown to be a proximate result of defendant's negligence; (This liability may be extended where the chain of causation extends to land not contiguous to property directly taken for aforesaid public improvement.) The claimant was held to have prover the defendant's negligence and was awarded damages for flooding of his land, as was an owner of land that was not contiguous to the property actually taken for the public improvement. (S. Scott-Fla)
W69-00487

BODICK V HARCLIFF MINING CO (OBSTRUCTION TO STREAMFLOW BY MINING WASTES).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00534

ALLEN V MORRIS BUILDING CO (SURFACE RUNOFF DAMAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00541

SHEEHAN V RICHMOND COUNTY (EMINENT DOMAIN AND HIGHWAY DRAINAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00547

4D. Watershed Protection

WATERSHED PROTECTION AND FLOOD PREVENTION.
16 USCA Secs 1001-1008 (1964).

Descriptors: *Water conservation, *Watershed management, *Flood control, *Water resources development, Water resources, Projects, Water utilization, Water policy, Cost sharing, Benefits, Federal government, State governments, Local governments, Legislation, Cost-benefit analysis, Water districts, Drainages, Multiple-purpose projects.

The act sets up a program whereby federal assistance may be rendered to any state, political subdivision of a state, or any district with authority to maintain and separate flood prevention or conservation projects. The purpose of the assistance is to cooperate with local governments in preventing erosion, flood water and sediment damages in the watersheds of the rivers and streams of the United States; and in furthering the conservation, development, utilization, and disposal of water and thereby preserving and protecting the nation's land and water resources. The Secretary of Agriculture is authorized to assist local organizations in preparing and carrying out plans for flood prevention or the conservation, development, utilization and disposal of water in watershed or subwatershed areas. The local organizations must supply the land for the project and pay its proportionate share as determined by the Secretary. However, the Secretary is impowered to make federal loans to finance the local costs. (Horner-Fla)
W69-00500

WATER POLICY ON RANGE AND FOREST LANDS,
Karl S. Landstrom.
J Farm Econ, Vol 34, No 5, pp 747-750, Dec 1952. 4 p.

Descriptors: *Watershed management, *River basin development, *Water conservation, Erosion control, Forest management, Sediment yield, Surface runoff, Watersheds (Basins), Forestry, River basins, Runoff, Mountains, Federal government, Water resources, River basin commissions, Sediment control, Missouri, Wildlife, Recreation.

An essential function of range and forest land is to safeguard watersheds and their water supplies. The president's Water Resources Policy Commission recommended a 9 point policy. Soil and forest conservation should occupy a major place in river basin programs. Federal farm and water resources policies should support conservation. The work of watershed management agencies should be coordinated into a single program for each basin and for the country. Techniques are required to measure accomplishments and to estimate the size of the task. Watersheds should be protected by curtailing improper uses of watershed lands. Federal mining laws need revision to provide development of nonmineral resources on mining claims. Expenditure for watershed management should increase in line with expended water developments, and conservation practices on private land should be enforced. There should be public acquisition of areas not suited to private conservation. Participation of operators and the public should increase in watershed management. (Rives-Fla)
W69-00527

EROSION OF COHESIVE SEDIMENTS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-00608

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

CO-OXIDATION OF ORGANIC MOLECULES BY METHANE-OXIDIZING BACTERIA GROWING AT THE EXPENSE OF METHANE,
Illinois Univ, Urbana.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-00407

ISOTOPIC ANALYSIS OF URANIUM IN NATURAL WATERS BY ALPHA SPECTROMETRY,
U S Geological Survey, Water Resources Division.
Kenneth W. Edwards.
U S Geol Surv Water-Supply Pap 1696-F, pp F1-F26, 1968. 26 p, 6 fig, 8 tab, 24 ref.

Descriptors: *Analytical techniques, *Uranium radioisotopes, *Radiochemical analysis, Ion exchange, Radioactivity, Spectrometers.
Identifiers: *Alpha spectrometry.

A method is described for the determination of U-234/U-238 activity ratios for uranium present in natural waters. The uranium is coprecipitated from solution with aluminum phosphate, extracted into ethyl acetate, further purified by ion exchange, and finally electroplated on a titanium disc for counting. The individual isotopes are determined by measurement of the alpha-particle energy spectrum using a high resolution low-background alpha spectrometer. Overall chemical recovery of about 90% and a counting efficiency of 25% allow analyses of water samples containing as little as 0.10 microgram/l of uranium. The accuracy of the method is limited, on most samples, primarily by counting statistics. (Knapp-USGS)
W69-00425

LINDANE ADSORPTION BY LAKE SEDIMENTS,
Wisconsin Univ., Madison.
Erik G. Lotse, Gordon Chesters Graetz, and Gerhard B. Lee.
Water Resources Center Rpt, July 25, 1967. 42 p, 10 fig, 10 tab, 5 ref. OWRR Project B-008-Wis.

Descriptors: Adsorption, Pesticide kinetics, *Insecticides, Bottom sediments, Lake soils, Radiochemical analysis, Organic matter, Bonding, Clay minerals, Particle size.
Identifiers: Chlorinated hydrocarbons, Multiple regression, Lindane.

Lindane (gamma isomer of benzene hexochloride) adsorption was determined on eight intact lake sediments using a radiochemical technique. Lindane adsorption was shown to be affected by sediment suspension concentration, organic matter content, lindane concentration, clay content and lindane-sediment ratio and to obey Freundlich's equation. As the lindane molecule is neutral and not subject to ionization, van der Waals forces and hydrogen bonding were considered the most feasible adsorption mechanisms. The chlorine atoms of lindane are the most likely bonding sites to hydroxyl groups residing on the surfaces of the organic and mineral components of the sediments.
W69-00621

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-II. INFLUENCE OF HYDRONIUM ION CONCENTRATION ON ABSORPTIVITY,
Rutgers Univ., New Brunswick, N. J.
Samuel D. Faust, and Edward W. Midulewicz.
Water Res, 1, 509-522, 1967. 29 p, 3 fig, 10 tab, 11 ref. OWRR Project A-012-NJ.

Descriptors: *Phenols, *Organic compounds, Industrial wastes, Water pollution, *Water pollution effects, Water pollution sources, Water quality, Chemical analysis, Chemical properties, Chemical reactions, *Analytical techniques, Data collections.
Identifiers: Halogenated phenols.

The oxidative coupling of 4-aminoantipyrine with several phenolic compounds has been examined with pH values of 8.0 and 10.0. The pH value influences this attack in two ways: (a) greater reactivity is observed at pH 8.0 as the phenol exhibits greater dissociation to a phenoxide ion, and (b) lesser reactivity is observed at pH 10.0 that is ascribed to a reduction of the electrophilic characteristics of the 4-AAP. This hypothesis was tested through a program to systematically sample 17 sites in 5 river systems of northeastern New Jersey and to examine these samples for phenol. In 84 of 153 split samples a reaction pH of 8.0 yielded higher phenol contents than the reaction pH of 10.0. In addition, 44 of these 84 samples were cases where negligible phenol contents were reported at the reaction pH of 10.0. The significance lies in the greater detectability (i.e., analytical sensitivity) of 4-AAP toward phenolic compounds at pH 8.0 than at pH 10.0. (Author)
W69-00622

REDUCING THE POLLUTION BURDEN OF FOOD PROCESSING PLANT WASTES,
California Univ., Davis.
George K. York, and Samuel A. Hart.

OWRR Project A-017-Cal. Water Resour Center Rept, Jan 1967. 25 p, 8 tab, 368 ref.

Descriptors: Bibliographies, Water quality, Water pollution, *Water pollution sources, Water pollution effects, *Waste water (Pollution), Wastes, Biochemical oxygen demand, Canneries, Foods, Nitrogen, Water pollution sources, Hydrogen ion concentration, Phosphates, Sulfates, Chlorides, California, *Industrial wastes.
Identifiers: Meat processing industry, Sacramento Valley, Calif, San Joaquin Valley, Calif.

Pollution burden parameters were measured in waste water from 3 tomato canneries, a frozen vegetable plant, a slaughter house, a cucumber pickle plant, and a winery and distillery located in the Sacrament and San Joaquin Valleys of California. The parameters were flow rate, concentration of solids, 5- and 20-day BOD, hydrogen ion concentration, total nitrogen, phosphates, chloride, and sulfates.
W69-00640

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE--PART I--A CRITIQUE,
Rutgers Univ. Water Resources Research Inst.
Samuel D. Faust, and Edward W. Mikulewicz.
Rutgers State Univ Rept, 1967. 30 p, 4 fig, 12 tab, 16 ref. OWRR Project A-012-NJ.

Descriptors: Water supplies, Water analysis, pH, Phenology, Phenols, Waste water, Oxidation, Chemical analysis, Chemical reactions, Water quality.

Quantitative determination of phenols in water and waste water is attempted by condensation with 4-aminoantipyrine and oxidation under alkaline conditions to a colored product. Major chemical factors that influence this reaction are pH value between 8.0 and 11.0, the type of aqueous buffer, and the type of substituted phenol. These 3 factors influence the analytical and molecular sensitivities as well as the wave length of maximum absorbance. A total phenol determination is not possible with the 4-aminoantipyrine technique as currently practiced.
W69-00645

5B. Sources of Pollution

ANALYSIS OF WATER QUALITY OF THE MAHONING RIVER IN OHIO,
U S Geological Survey.
Gene A. Bednar, Charles R. Collier, and William P. Cross.
U S Geol Surv Water-Supply Pap 1859-C, pp C1-C32, 1968. 32 p, 21 fig, 1 plate, 5 tab, 3 ref.

Descriptors: *Water quality, *Thermal pollution, *Dissolved oxygen, *Dissolved solids, Waste water disposal, Chlorides, Streamflow, Ohio.
Identifiers: *Mahoning River, Iron concentration, Sulfate load.

Certain water-quality characteristics of the Mahoning River, Ohio, were investigated in order to establish water-quality criteria based on hydrologic conditions and water use. Water temperatures at Princetown and Leavittsburg, which ranged from the freezing point to 78 deg F during 1963-1965, were not affected by thermal loading; however, downstream from Leavittsburg, industrial cooling caused critical thermal loading during periods of low streamflow; 104-108 deg F at Lowellville and Struthers. The dissolved-oxygen content was frequently depleted by oxygen-consuming materials and warmed water from industrial and municipal wastes discharged into the river's lower reaches. At Lowellville, the river water had a dissolved-oxygen content of 5 ppm or less for 67% of the time, and 3 ppm or less for 16% of the time; at Leavittsburg and Princetown this was at acceptable levels. The dissolved-solids concentration was 150-450 ppm at Leavittsburg, and 200-650 ppm at Lowellville, where industrial use caused the higher value. Chloride content (42--108 ppm) was acceptable. Sulfate load from waste disposal and acid mine drainage ranged from 28 to 2,420 tons/day, at different times, depending on location. Iron concentrations were frequently over 20 ppm between Leavittsburg and Lowellville. (Llaverias-USGS)
W69-00428

WATER QUALITY CONTROL AND MANAGEMENT, SNAKE RIVER BASIN.
Federal Water Pollution Control Administration.

Fed Water Pollut Contr Admin Report, 72 p, Sept 1968. 12 fig, 33 photo, 12 tab.

Descriptors: *Water quality control, *River basin development, *Pacific Northwest U S, Water Quality Act, Water pollution sources, Water pollution control, Flow control, Waste treatment, Radioactive wastes.
Identifiers: Snake River Basin.

Summarization is made of various studies which have provided the impetus to Federal-State Water pollution control planning in the Snake Basin. Water quality is now impaired for municipal supply, recreation, fish production, and aesthetic enjoyment in many places; pollution problem areas are indicated on a map. Increase in pollution is occurring because of larger waste discharges and because of a complex system of improvements for irrigation and power, which cause low flows, increased temperature, and decreased capacity to assimilate wastes. Fish kills, thermal pollution, bacterial contamination, and aquatic growth are problems which make portions of the river aesthetically offensive. Groundwater in the upper basin is a largely undeveloped resource which must be protected and used to supplement surface water. The low-level radioactive wastes of the National Reactor Testing Station, which overlies the recharge basin of the Snake River aquifer, must be properly managed to protect both groundwater and the river. Specific measures to reduce contamination are listed. Water resource development data, waste sources, treatment, quality criteria, and other topics are presented in tables and graphs. (Knapp-USGS)
W69-00438

STEBBINS V ORANGEBURG MFG CO (STREAM POLLUTION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00536

NORTH DADE WATER CO V ADKEN LAND CO (ENJOINING LAKE POLLUTION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00561

AN EVALUATION OF THE USE OF ESCHERICHIA COLI SEROTYPES AS A MEANS OF TRACING MICROBIAL POLLUTION OF WATER,
Pennsylvania State Univ., University Park.
Paul J. Glantz, and Thomas M. Jacks.
Inst Res Land and Water Resour Rept 1967. 57 p, 8 fig, 11 tab, 25 ref, 2 append, disc. OWRR Project A-008-Pa.

Descriptors: *Water pollution, *Pollution abatement, Sewage, Sewage treatment, *Tracers, Bacteria, *E. Coli, Coliforms, Microorganisms, Sewage bacteria, Effluents.

Utilization of E. coli serotypes as a means of tracing microbial pollution in water was studied. Objectives of the study were: (1) to evaluate the significance of the survival of coliform bacteria and Escherichia coli serotypes in effluent; (2) to determine influence of effluent on the occurrence of coliform bacteria in birds in the spray area; and (3) use of coliform density for determining microbiologic purity of waste water. Results showed that in chlorinated effluent, members of the Klebsiella-Aerobacter group outnumbered E. coli by a ratio of 9:1. Sewage effluent irrigation had no influence on the occurence of coliform bacteria in wild birds and percolation of effluent through soil to a depth of 2-4 ft was sufficient for reclamation of renovated effluent. There was a general rise in fecal coliforms through May to July, declining in August and September. The E. coli serogroups isolated at the different sampling points were an indication of their probable upstream source. Results of this study indicate that tracing microbial pollution by serologically identifying the E. coli strains is feasible.
W69-00625

CHEMICAL REACTOR THEORY APPLIED TO MODELING THE DYNAMICS OF A CONTROL SYSTEM FOR WATER QUALITY OF A RIVER: PHASE 1-A FEASIBILITY STUDY,
Maine Univ., Orono.
Edward G. Bobalek.
Univ Maine Rept., July 1967. 39 p, 8 fig, 5 tab, 2 append, 33 ref. OWRR Project B-001-Me.

Descriptors: Feasibility studies, *Simulation, River systems, Maine, *River regulation, *Water quality, *Estuaries, Water pollution, Saline water-freshwater interfaces, Mixing, Tidal waters, Dispersion, Computer models, *Mathematical models, Fresh water.
Identifiers: Penobscot Estuary, Maine.

The objective of this study was to provide an exploratory appraisal of the feasibility of conducting an extensive experimental probing of a selected river system. Such experiments would have the ultimate goal of providing an accurate and workable model of 1 typical system in the State of Maine. Such a model would be used to implement an overall control scheme which can provide a basis for engineering decisions on regulating waste discharges into the river under conditions which do not overload the capability of the river to purge itself and restore water qualities affected by pollution loading. The Penobscot River estuary was selected as representative of conditions existing in the state with respect to water pollution. The key problem requires prediction of the velocity profile in response to intermixing of tidal and fresh waters. Appraisal of such intermixing correlations is of special importance in determining residence times for pollutants which are nullified by available oxidation and dilution mechanisms. The determination of mixing effects is projected as a primary goal of Phase II which continues this study through acquisition and analysis of data which can permit more precise development of the models here proposed as a starting foundation for the experimental plan.
W69-00642

THE EFFECTS OF TEMPERATURE AND DENSITY GRADIENTS UPON THE MOVEMENT OF CONTAMINANTS IN SATURATED AQUIFERS,
Alabama Univ., University.
Harold R. Henry.
Univ Alabama Rpt, 1967. 14 p, 4 fig, 26 ref. OWRR Project B-004-Ala.

Descriptors: *Contamination, *Aquifers, Convection, *Dispersion, Waste disposal, Thermal properties, Model tests, Saturation zones, Seepage, Numerical method, Laboratory tests, Permeability, Porosity, Porous materials, Bibliographies, Darcys law.
Identifiers: Temperature profiles, Thermal diffusion.

Experimental and analytical studies were made on a simplified geometric model. A horizontal, lateral temperature gradient was imposed upon a horizontal channel of square cross section containing sand saturated with water. Velocities were measured by

tracing dye patterns along the glass walls and top of the channel. Temperatures were measured by networks of copper-constantan thermocouple junctions spaced throughout the channel. Experimental temperatures and velocities indicated the presence of a convection current which increased in strength as the temperature gradient increased. By defining a stream function psi and by appropriate normalization of the variables, the governing equations were reduced to an expression which is parameter free except for a value, M, which is a modification of the Rayleigh number. Finite difference solutions are obtained for several values of M and for several boundary conditions. The effective value of thermal diffusivity is found to be about 50 times larger than the usual value because of the dispersion which occurs when fluid moves through the tortuous channels within the porous bed.
W69-00651

TRAVEL OF ABS AND AMMONIA NITROGEN WITH PERCOLATING WATER THROUGH SATURATED OAHU SOILS,
Hawaii Univ., Honolulu.
Reginald H. F. Young, L. Stephen Lau, and Nathan C. Burbank.
Water Resour Res Center, Techn Rep 1, Jan 1967. 54 p, 13 fig, 7 tab, 32 ref, 4 append. OWRR Project A-001-Hi.

Descriptors: Percolating water, Infiltration, Detergents, Pollutants, Nitrogen compounds, Soil contamination, Cesspools, Sewage disposal, Groundwater movement, Absorption, Adsorption.

A laboratory study was undertaken to determine the ability of 4 Oahu soils, Lolekaa, Lahaina, Manana, and Wahiawa, to remove ammonia, ABS, and coliforms from water percolating continuously through saturated soils. Soils utilized were chosen on the basis of their wide occurrence on the island areas where percolating water may enter directly and in quantity into the ground water body that principally provides the island's domestic water supply. All 4 soils had a high clay content and low pH. Laboratory tests were conducted with 10-ml burettes and subject to continuous saturated flow. Each contaminant was applied in solution 1 at a time to a fresh soil sample. Tap water was used for ABS and ammonia nitrogen while sewage was used to study coliform removal. The results of coliform removal from percolating liquids were not conclusive because of small soil samples and loading procedures. Preliminary tests verified some general principles developed elsewhere for effective coliform removal by ground disposal of sewage. The final clarifier effluent from a trickling filter was passed continuously through a 30 in. column of Wahiawa soil and an initial coliform reduction of about 90 % was effected.
W69-00652

A SIMPLIFIED PHYSICAL MODEL FOR STUDYING ASSIMILATIVE CAPACITY,
Georgia Inst. of Tech., Atlanta, and Michigan Univ., Ann Arbor.
W. E. Gates, K. H. Mancy, and F. R. Shafie.
Pap, 21st Ind Waste Conf, Purdue Univ, May 1966. 42 p, 17 fig, 27 ref. OWRR Project A-003-Ga.

Descriptors: *Dissolved oxygen, *Water, Water quality, *Oxygen sag, Models, Water analysis, *Oxygenation, Oxygen.

This is a report on the use of a physical model in an attempt to define and evaluate the assimilative capacity of natural waters. Most of these endeavors have utilized dissolved oxygen depletion and/or replenishment as the indicating parameter. Consequently, when dealing with streams, it is generally accepted that the assimilative capacity refers to the oxygen which is available to the biosphere, from or through the hydrosphere, within selected constraints. Because dissolved oxygen content of the hydrosphere is a renewable resource, assimilative capacity is primarily controlled by the rates, the relative rates, and the changes in the rates which dictate the oxygen transfer from the atmosphere to the hydrosphere (surface reoxygenation) and from the hydrosphere to the biosphere (deoxygenation). The physical model described does not permit evaluation of deoxygenation and reoxygenation processes when they are proceeding under identical conditions. The results can be considered only in general terms with respect to other systems, but should be considered as indicative of probable inadequacies in present techniques of assimilative capacity evaluation.
W69-00673

HYDROLOGIC STUDY OF A WASTE-DISPOSAL PROBLEM IN A KARST AREA AT SPRINGFIELD, MISSOURI,
U S Geological Survey, Rolla, Missouri, Water Resources Division.
E. J. Harvey, and John Skelton.
U S Geol Surv Prof Pap 600-C, pp C217-C220, 1968. 4 p, 3 fig, 2 tab.

Descriptors: *Water pollution, *Path of pollutants, *Subsurface drainage, *Karst, Municipal wastes, Sewage effluents, Sinks, Dye release.
Identifiers: *Waste-disposal problem, Seepage runs, Springfield, Missouri.

In a study of a pollution problem in the Springfield area, dye tests, seismic studies, and discharge measurements have proved the existence of a complex naturally developed underground drainage system. Effluent from a sewage plant with secondary treatment travels underground, where it cannot be aerated, and reappears in a downstream spring. Efforts to restrict the effluent to the stream into which it is originally discharged have been only partly successful. Measurements of streamflow and spring discharge show that the natural inflow of water to the spring is large and that it helps to dilute the sewage effluent to a more acceptable level. The primary area of groundwater recharge is agricultural land west of Springfield. Preservation of this area in its present land use and the carrying out of simple corrective measures on the creek carrying the effluent would help alleviate the pollution problem. (Author)
W69-00695

5C. Effects of Pollution

THE EFFECTS OF CLIMATE UPON THE WORK CAPACITY AND CARDIAC AND OPERCULAR CYCLES IN FRESH-WATER FISH,
Massachusetts Univ, Amherst.
John L. Roberts.
OWRR Project A-013-Mass, Proj Completion Rep, Jan 1968. 2 p.

Descriptors: Aquatic animals, *Bioassay, Bullheads, *Climates, Flow, Aquatic environment, *Fish, *Water quality, Physiological ecology, *Thermal stress, Sunfishes, *Swimming, *Temperature, Trout, Ecology, Thermal pollution.

This project investigates sublethal responses by fish to environmental changes that might serve as indexes of water quality. Primarily the study was to describe effects of sustained swimming on heart and ventilation rates of 3 species. The fish chosen were the pumpkinseed sunfish (Lepomis gibbosus); the bullhead, (Ictalurus nebulosus); and the trout (Salmo trutta). Cardioacceleration and increases in ventilation rates were found to occur with enforced swimming in all species. In trout, gill ventilation frequency, but not cardiac frequency, was found to relate in a direct proportionality to swimming speed. Flow velocity of water past the head does not significantly alter the resting pattern of ventilation as does swimming. The secondary aim has been to test selected indexes (cardiac and opercular frequencies). Rapid warming was selected as the index and preliminary testing and recording of these events was tried with goldfish, (Carassiums auratus). The results were unsatisfactory but subsequent experiments at Bristol, England, have shown these 2 rate activities to be highly sensitive indexes of sublethal thermal stress.
W69-00416

WATER TEMPERATURE CRITERIA TO PROTECT AQUATIC LIFE,
Maryland Univ, Natural Resources Institute, Solomons.
J. A. Mihursky, and V. S. Kennedy.
Natur Resour Inst, Contrib 317, Reprint, Amer Fisheries Soc Publ 4, pp 20-32, 1967. 13 p, 11 fig, 43 ref. OWRR Project A-002-Md.

Descriptors: Animal metabolism, Animal behavior, Aquatic animals, *Aquatic life, Estuaries, Fish, Mortality, *Temperature, Temperature control, Thermal pollution, Regulation, Water pollution, Water quality, Water pollution sources, *Aquatic environment.

The ecological significance of temperature in the aquatic habitat is discussed in relation to the thermal loading of ecosystems by electric power plants. It is pointed out that nuclear plants will produce greater amounts of waste heat per kilowatt of electricity than the conventional fossil fuel plants. Effects of temperature on behavior, metabolism, and mortality of aquatic organisms are described to indicate the difficult problems involved in determining acceptable standards for a healthy fish population. A multivariate analysis of interactions between temperature and other environmental factors is suggested. Standards for temperature regulation are described for three ecosystems: (1) cold-water salmonid streams, (2) warm-water centrarchid environments, and (3) estuaries.
W69-00418

ROLE OF NEMATODES AND RELATED MEIOFAUNA AFFECTING FRESH WATER QUALITY IN RHODE ISLAND,
Rhode Island Univ, Kingston.
G. J. Stressel.
OWRR Proj No B-003-RI, Completion Rep, July 1968. 9 p, 2 tab.

Descriptors: *Aquatic microbiology, *Nematodes, *Indicators, *Water pollution, Rhode Island, Water pollution effects, Water Resources Research Act.
Identifiers: *Meiofauna.

Sediment cores, overlying water samples, and samples of the meiofauna of Hunt River, Rhode Island, were taken at seven stations above and below sources of pollution to determine the relationships between fauna and pollution. Physicochemical measurements were made concurrently with sampling. Maximum nematode populations occurred in winter and spring when water temperature was about 8 deg C. Predaceous nematodes were more numerous when organic matter was over 12%. Dissolved oxygen, phosphate, and carbon dioxide concentrations and nematode or meiofaunal populations could not be correlated. Population dynamics at polluted and unpolluted sites were similar, but the predaceous nematode genus Monochus occurred only at polluted sites; it is a promising pollution indicator. (Knapp-USGS)
W69-00427

PLANKTONIC PHOTOSYNTHESIS AND THE ENVIRONMENT OF CALCIUM CARBONATE DEPOSITION IN LAKES,
Minnesota Univ., Minneapolis, Limnological Res Center.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00446

WATER QUALITY ALTERATION THROUGH ACID AND HEAT POLLUTION IN A 1500 ACRE RESERVOIR,
Missouri Univ., Columbia, Water Resour Res Center.
Robert S. Campbell, James. R. Whitley, and Edward R. Brezina.
Proj Rep 1, Univ Mo, Mar 1966. 33 p, 8 fig, 9 tab, 1 ref. OWRR Proj A-004-Mo.

Descriptors: Water quality, *Water pollution, Turbidity, Heated water, Mine acids, Fly ash, Plankton, Aquatic life, Alkalinity, pH, Animals, *Fishkill, Acidity, Hydrogen ion concentration, *Thermal pollution, Industrial wastes.

An investigation was made to evaluate the influence of several effluents on water quality, the biota, and the autotrophic aspects of community metabolism. Certain physical and chemical conditions vary throughout the reservoir in a pattern related to the site of hot water discharge. The most conspicuous environmental variant is water temperature, which ranges from 37 deg C at the steam plant discharge canal to 21 deg C at the western end of the lake. Dissolved oxygen range was 0.2 to 11.0 ppm, with the lower values from the deeper more stagnant water at the eastern and western ends of the lake. No evidence was found of alkaline drainage into the reservoir. At the time of reported fish kills, 1962-63, fly ash was piled adjacent to the reservoir. Fly ash is now stored in bins protected from the weather. Preliminary inspection of the plankton and bottom fauna suggests that the fauna is not rich.
W69-00450

PLANKTON HETEROTROPHY IN A NORTH CAROLINA ESTUARY,
North Carolina Univ., Raleigh, Water Resour. Res. Inst.
John E. Hobbie.
Proj Completion Rep, Univ N Car, Nov 1966. 9 p, 2 fig, 1 tab, 9 ref. OWRR Proj A-015-NC.

Descriptors: *Plankton, Indicators, *Eutrophication, Domestic wastes, Phosphates, *Effluents, *Bacteria, Radioactivity techniques, *Estuarine environment.

The heterotrophic ability of the bacteria of the plankton was studied utilizing uptake of radioactive organic compounds. The method was developed in fresh water, but proved to be adaptable to estuarine conditions. This project, the first phase of a larger study of bacteria in the aquatic ecosystem, found that glucose and acetate were taken up by bacterial uptake systems and that the uptake rate could be analyzed by the equations of enzyme kinetics. The maximum uptake velocity was a good indication of relative heterotrophic activity, and reached a peak during the summer in the Pamlico River estuary. This parameter was a rapid and sensitive indicator of eutrophication as peaks of activity found in a 30-km survey were correlated with domestic wastes and effluent from phosphate mining activity.
W69-00456

GAME AND FRESH WATER FISH - CONTAMINATING FRESH WATERS.
Fla Stat Sec 372.85 (1967).

Descriptors: *Florida, *Legislation, Water law, Legal aspects, Water pollution, *Pollution abatement, Water pollution sources, Mine water, Sawmills, State governments, Water pollution effects, Fish populations, Fish conservation.

Florida Statute section 372.85 declares that it shall be unlawful for any person or persons, firm or corporation to cause any dye-stuff, coal tar, oil, sawdust, poison or deleterious substances to be thrown, run or drained into any of the fresh running waters in quantities sufficient to injure, stupefy, or kill fish which may inhabit the same at or below the point where any such substances are discharged; provided, that it shall not be a violation of this section for any person, firm or corporation engaged in any mining industry to cause any water handled or used in any branch of such industry to be discharged on the surface of land where such industry or branch thereof is being carried on under such precautionary measures as shall be approved by the game and fresh water fish commission. (R. Smith-Fla)
W69-00510

ADAIR V FRISBY (DAMAGES FROM SALT WATER DISCHARGE).
State of Arkansas, Little Rock.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00558

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Walnut Creek, Calif; Washington Univ, Seattle.
Denny S. Parker, and James A. Crutchfield.
Water Resour Res, Vol 4, No 2, pp 233-246, Apr 1968. 14 p, 9 fig, 2 tab, 6 ref.

Descriptors: Project feasibility, Project planning, *Water pollution, Water development, Water quality, Water requirements, Water management, Water resources, Water utilization, Waste disposal, Pollution abatement, Economics, *Benefit-cost ratios, Public works, Time, Costs, Benefits, *Social values.
Identifiers: Waste water (Pollution), Waste management, *Cost-benefit analysis, Water resources development, Long-term planning.

Economic evaluation of pollution-causing water projects cannot neglect social costs of water pollution, i.e., the net loss of benefits from an alternative use if the water was not used for waste disposal. Planners have often been concerned only with conveying wastes out of their jurisdiction, choosing the most expedient solution. The resulting long-term social costs are often sufficiently large that a different system would have been selected if social costs had been considered initially. The valuation of benefits and costs from major public projects requires long-term forecasts. Long-term social costs cannot be neglected nor ignored when there are demands for amenity services of water. If social costs of water pollution were adequately evaluated, a higher level of investment might be justified for waste management. The obligation to future generations may have a sound economic basis for maintaining higher levels of water quality than can be justified by current benefit-cost practices. (USBR)
W69-00582

BIOCHEMICAL CAPABILITIES OF SURFACE FILMING BENTHIC BACTERIA IN FRESH WATER SYSTEMS,
Missouri Univ., Kansas City.
Russell G. Barnekow, Jr., and Edward L. Davis.
Water Resour Res Center Rept 2, Jan 1967. 24 p, 6 plates, 1 tab, 15 ref. OWRR Project A-005-Mo.

Descriptors: *Bacteria, *Aerobic bacteria, Pseudomonas, Oil wastes, Mycobacterium, *Oxidation lagoons, Biodegradation, Industrial wastes, Waste treatment, Organic matter, Sulfur bacteria, Tertiary treatment, *Cultures.

Utilization of glucose and sorbitol by large, heterogeneous bacterial populations obtained from a petro-chemical oxidation lagoon was examined. Two population types were observed: one which used glucose and sorbitol with no lag period and another which exhibited an extended lag period before substrate utilization was detected. Simultaneous utilization of glucose and sorbitol by populations which did not exhibit a lag period was observed. The extended lag period shown in other populations was attributed to preferential use of endogenous materials. These populations also demonstrated adaptation to exogenous substrates. The populations examined were primarily composed on non-fastidious, oxidative aerobes.
W69-00624

BIOTIC RESPONSE TO POLLUTION REDUCTION IN A RIVER,
Michigan State Univ., East Lansing.
Allen W. Knight, and George H. Lauff.
W K Kellogg Biology Sta Rep, 1967. 56 p, 10 fig, 16 tab, 14 ref. OWRR Project A-010-Mich.

Descriptors: *Stream pollution, *Pollution abatement, Rivers, Water pollution control, Sludge worms, Sludge, Aquatic life, Lake Michigan, Dissolved oxygen.

A study of the Kalamazoo River was conducted to ascertain conditions existing prior to initiation of a pollution abatement program. The river was found to be grossly polluted in a 20-mi stretch below the city of Kalamazoo. Decomposition of organic matter in water and in extensive silt accumulations frequently depleted the dissolved oxygen for 20 mi or more. Sewage fungus covered the surface of sludge deposits and stationary objects in the water while extensive numbers of sludge worms frequently occurred as red fringe along the river margins. Only a few of the more tolerant macroinvertebrates and fish occurred in the very polluted zone. In lower reaches of the river considerable self-purification was accomplished and a return of many of the macroinvertebrates and game fish was noted. The river prior to its discharge into Lake Michigan has accomplished considerable self-purification but carried a large load of suspended and dissolved materials into Lake Michigan.
W69-00631

LIMNOLOGY, PRIMARY PRODUCTIVITY, AND CARBONATE SEDIMENTATION OF MINNESOTA LAKES,
Minnesota Univ.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00632

SURVEY OF THE NATURE AND MAGNITUDE OF THE WATER RESEARCH NEEDS OF THE TEXTILE INDUSTRY OF GEORGIA,
Georgia Institute of Technology, Atlanta.
William L. Hyden, Douglas F. Becknell, and Telford E. Elders.
OWRR Project A-010-Ga. Water Resour Center Rept, June 1966. 27 p, 1 photo, 1 map, 2 append.

Descriptors: *Textiles, *Industries, Industrial wastes, Waste water disposal, *Water pollution control, pH, Effluents, Water chemistry, Waste water treatment, Water reuse, Georgia, Water temperature, Water pollution sources, *Water pollution.
Identifiers: Water use, *Textile industry.

The investigation described herein, consisted of a field survey of 48 representative wet-processing textile mills in the state of Georgia to determine the kinds and frequency of occurrence of serious problems related to water use and waste disposal. From data obtained from plant inspections and interviews, 12 different problems were found to occur at 3 or more of the 48 mills. Excessive hardness of the raw water supply was experienced at 17 mills. Miscellaneous problems of wastewater disposal were found at 11 mills. Analysis of survey results, supported by consultation with industry leaders and experts in sanitary engineering and water chemistry, led to the conclusion that some of the most common problems were subject to solution by known techniques. Others, that occurred less frequently, are problems with no known technically or economically feasible solution. Outstanding is the problem of excessive color in wastewater effluent. A brief discussion includes the 12 most frequently encountered problems. Possible solutions and recommendations regarding research are suggested, among these development of more efficient processing equipment and management techniques.
W69-00639

ENHANCEMENT OF RECREATIONAL USES OF ESTUARINE WATERS THROUGH STUDY OF POTENTIAL CONTROL METHODS FOR STINGING SEA NETTLES,
Maryland Univ., College Park.
David G. Cargo.
Natur Resour Inst Prog Rpt, Dec 1966. 26 p, 5 plate, 3 tab, 14 ref, disc. OWRR Project B-001-Md, B-002-Md.

Descriptors: *Foods, Laboratory tests, Field tests, Water, Biology, Research and development, Water, Temperature, Seasons, Zoology, *Sea nettles, Preditation, Spawning.
Identifiers: *Polyps, *Nudibranch, Medusa.

A number of laboratory and field oriented experiments and observations are described. Temperature tolerance of polyps of the sea nettle showed that they encyst at 4 C. Most polyps set on the undersides of substrates. Predation upon polyps by the nudibranch Coryphella pellucida is revealed. Observations on the winter jelly fish showed that this species is seasonally opposite to the summer nettle and has all the same stages. Growth of medusae, variation in seasonal abundance and setting patterns of planula larvae were examined. Maximum growth observed was from 3 to 170 mm in 33 days. Peaks of abundance and spawning take place in late July and early August. A laboratory experiment showed that the ctenophore is an acceptable and nutritious food for sea nettles.
W69-00647

SURFACE-WATER CHEMISTRY OF SOME MINNESOTA LAKES, WITH PRELIMINARY NOTES ON DIATOMS,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00659

5D. Waste Treatment Processes

OPTIMAL AERATION SYSTEMS,
Kansas State University, Manhattan.
L. E. Erickson.
Kansas Water Resour Res Inst, Proj Completion Rep, Kansas State Univ, Aug 1967. 41 p, 14 fig, 3 tab, 22 ref, 2 append. OWRR Project B-001-Kann.

Descriptors: Biological treatment, *Activated sludge, *Aeration, Mixing, Hydraulic models, *Mathematical models, *Optimization, Analysis design.

The pattern of flow into the system, the recycle flow, and the mixing within the system are important parts of the hydraulic regime of activated sludge systems. Optimization procedures are used to determine the optimum hydraulic regime for several activated sludge systems. Mathematical models of several step aeration systems are developed and a discrete version of the maximum principle is used to optimize the hydraulic regime in these step aeration systems. The results of this research indicate that the constant K sub 1, which is the dimensionless organic nutrient concentration at which the observed specific growth rate is one-half the maximum value, is an important parameter in selecting the optimal hydraulic regime. This research illustrates some of the uses of mathematical modeling and optimization in the analysis and design of biological waste treatment systems.
W69-00408

OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS,
New Holland Machine Co, New Holland, Pa and Massachusetts Univ, Amherst.
N. W. Webster, and J. T. Clayton.
OWRR Project A-009-Mass, Mange Farm Animal Wastes, Amer Soc Agr Eng, St. Joseph, Mich, pp 61-65, 1966. 5 p, 14 fig, 2 tab, 20 ref.

Descriptors: Waste disposal, *Waste treatment, *Farm wastes, *Cattle, *Aerobic bacteria, *Anaerobic bacteria, Operations, Settling basins, Dairy industry, Biochemical oxygen demand.

Two aerobic waste-treatment systems were designed and tested for use in treating dairy manure. The systems were combinations of aeration and settlement for the purpose of reducing the pollution capabilities of the waste and to make possible the use of treated effluent for transporting fresh waste. The designed systems were first tested on a bench-scale system, and results showed that the loadings were too heavy. The loadings were reduced to 0.044 lb of volatile solids per system and rerun. The second test was satisfactory and loadings and containers were scaled up 100 times to 4.4 lb of volatile solids per system with tank sizes of 1000, 750, 500, and 300 gal. This pilot model was run for 5 months before it was terminated. System A, the anaerobic primary settlement and secondary aeration system was functioning and could have been continued. System B, primary aeration with secondary settlement, did not operate satisfactorily for the full 5-month test period. The system suited for agricultural uses was System A, with the addition of a small sediment tank with provisions for returning the settled solids to the primary settlement tank. This added feature would prevent an anaerobic condition from developing in the final sedimentation tank.
W69-00413

EFFECT OF NITRIFICATION OF ORGANIC WASTES ON WATERS IN THE NATURAL ENVIRONMENT,
Maine Univ, Orono.
K. Keshavan.
Water Resour Center Proj Completion Rep, June 1967. 56 p, 37 fig, 7 tab, 18 ref. OWRR Project A-003-Me.

Descriptors: Nitrification, Chemical reactions, Nitrates, Nitrites, Biochemical oxygen demand, Dissolved oxygen, Water purification, Water quality.

It is currently recognized that the biochemical oxygen demand of streams, estuaries and lakes can not always be reliably determined from data obtained in the laboratory. This is because nitrification is suppressed in these laboratory tests. Nitrification and oxidation of carbonaceous organic compounds occurring concurrently in natural bodies of water will utilize more oxygen than predicted by the oxygen sag curve. As a result, such practices as the classification of streams may be based upon erroneous BOD information. This research has shown that nitrification (oxidation of ammonia by nitrifying bacteria) becomes very significant in the presence of an active flora of nitrifying bacteria. It is more pronounced if the waste contains nitrogenous materials such as proteins and similar compounds. These compounds can be expected in wastes from starch plants, meatpacking plants and many other industries. The research has also shown that if the stream or lake is on the alkaline side (pH greater than 7.5), a further increase in the activity of the nitrifying bacteria can be expected. It is therefore, very important to consider the natural conditions of the receiving body of water before an evaluation of the oxygen resource is made.
W69-00419

THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE,
Mississippi State Univ., State College, Water Resour Res Inst.
Lewis R. Brown, Robert G. Tischer, and Cornell M. Ladner.
Miss State Univ, June 1967. 55 p, 26 fig, 6 tab, 5 ref. OWRR Proj A-007-Miss.

Descriptors: Sewage, Waste treatment, Microbiology, *Microorganisms, *Sewage treatment, Domestic wastes, Temperature, Biochemical oxygen demand, Chemical oxygen demand, *Coliforms.

Studies were conducted at temperatures of 30, 45, 55, and 65 deg C. Suspended solids (90%) removals were the same at all temperatures employed while the settleable solids were reduced 80% in the 30 deg C treatment and 58% in the 55 deg C treatment. BOD reductions (70%) were the same at all temperatures tested while the COD removals decreased with increases in temperature. E. coli, an unidentified enterococcus, and the enteric pathogens Salmonella paratyphi and Shigella sonnei were destroyed 30 minutes at 55 deg C and 10 minutes at 65 deg C. The bacteriophage for E.coli 11033-B was considerably more heat stable but was inactivated at 55 deg C by 80.3, 97.9, and 99.9% in sewage, distilled water, and nutrient broth, respectively. There were 1000 facultative thermophiles per ml in the sewage employed. The population growing at temperature of aeration reached 100 million organisms per ml for the 30, 45, and 55 deg C treatment and 10 million organisms per ml for the 65 deg treatment. Thermophiles isolated from normal domestic sewage after aeration at 55 deg C were either Pseudomonas aeruginosa (achromogenic strain) or members of the genus Bacillus. Protozoa were extremely effective in reducing the turbidity and COD of the 55 deg treatment effluent.
W69-00449

HIGH-RATE ROTARY VACUUM FILTRATION,
Rutgers Univ., New Brunswick, Water Resour. Res. Inst.
F. W. Dittman.
Rutgers Univ., 1967. 4 p, 1 tab, 3 ref. OWRR Proj A-004-NJ.

Descriptors: Filtration, *Sludge, Filters, *Sludge treatment, Sewage treatment, Sludge disposal, Waste disposal, Calcium carbonate, *Waste treatment.
Identifiers: Filtration rate, Sludge cake.

An economic study of an existing waste treatment plant indicated that sludge filtration might be an acceptable alternative to the existing process of transportation and ocean dumping, if higher than usual filtration rates could be obtained. Study of the several problems of the variation in filtration rate of aqueous calcium carbonate, suspensions gave numerical values for increase in filtration rate which would result from operating a rotary filter at high speed with a very thin cake. Various means of applying energy to the membrane for rapid continuous separation of thin filter cake are discussed.
W69-00455

RECOVERY OF WARP SIZES,
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
Harley Y. Jennings.
Univ N Car, Proj Completion Rep, June 1966. 2 p. OWRR Proj A-016-NC.

Descriptors: *Water pollution control, *Water pollution sources, *Water reuse, *Industrial wastes, Liquid wastes.
Identifiers: *Textile industry.

One phase of study included a search of the literature and preparation of annotated bibliography covering 297 papers on textile wastes. The second phase included an exploratory investigation of the recovery and reuse of textile size materials. Carboxymethylcellulose (CMC) was dissolved from cotton warp with minimal amounts of water and the resulting solution used as the basis for further sizing formulation. Experiments disclosed that one-third of applied CMC could be removed from the sized warp obtaining a 2 percent solution. New formulations prepared from this solution gave satisfactory performance. Warps passed through boiling water to remove waxes and pectins containing 70 percent moisture picked up sufficient CMC from formulation to perform satisfactorily on testing equipment.
W69-00457

VERMONT WOOLEN CORP V WACKERMAN (WATER POLLUTION ABATEMENT).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00554

ENZYMES AND CATALYSTS FOR PURIFICATION OF INDUSTRIAL WASTE WATER,
Oklahoma State Univ., Stillwater.
James W. Fulton.
Water Resour Inst, Oklahoma State Univ, June 1966. 37 p, 70 ref, append. OWRR Project A-007-Okla.

Descriptors: *Organic compounds, *Water purification, *Enzymes, Phenols, Chemical reactions, Chemical wastes, Industrial wastes, Catalysts.

The purpose of this study is to initiate research in the use of catalyst and enzyme systems for industrial waste-water purification. Records have been assembled on the known undesirable waste-water impurities. The literature has been searched for enzyme and bacteria systems which are known to decompose toxic materials. The decomposition of phenolic compounds has been emphasized, as an example. Suggestions for further research have been given.
W69-00619

THE EFFECT OF ELEVATED TEMPERATURES ON THE MICROFLORA OF NORMAL DOMESTIC SEWAGE,
Mississippi State Univ., State College.
Lewis R. Brown, Robert G. Tischer, and Cornell M. Ladner.
Water Resour Res Inst Rept, July 1966. 20 p, 3 tab, 3 ref. OWRR Project A-007-Miss.

Descriptors: *Microorganisms, *Sewage treatment, *Domestic wastes, Sewage, Temperature, Biochemical oxygen demand, Coliforms, Aeration, Chemical oxygen demand, Waste treatment.

Treatment of normal domestic sewage at elevated temperatures destroyed the enterococcal and coliform populations nearly completely at 65 deg C and is only slightly less effective at 55 deg C. The enteric pathogens, Salmonella paratyphi and Shigella sonnei, are destroyed within minutes at these elevated temperatures. The effluent from a high-temperature sewage stabilization process will not need chlorination. Approximately 100,000 facultative thermophiles/ml appear capable of growing at 55 deg C in the normal domestic sewage employed in these studies, sine thermophilic count at 55 deg C remained about 100 thousand ml when treatment temperature was 30 deg C and the mesophilic count at 30 C remained 100 thousand/ml microorganisms (or dropped off to about 100 thousand) when the treatment temperature was 55 deg C. More organisms appear in normal domestic sewage that grow at 45 deg C than there are that grow at 55 deg C or 65 deg C. The 65 deg C temperature appears to be more detrimental to the mesophilic population than the other temperatures employed. The reductions in COD and suspended solids of the influent sewage averaged more than 90% in all cases.
W69-00634

INCREASED GAS TRANSFER IN BIOLOGICAL REACTORS OF INTEREST IN WASTE WATER RECLAMATION,
Delaware Univ., Newark.
Iraj Zandi, and Miriam S. Shane.
Univ. Delaware Rept., June 1967. 24 p, 13 fig. OWRR Project A-001-Del.

Descriptors: *Activated sludge, *Biodegredation, Sludge treatment, Sludge digestion, Chemical reactions, Sewage treatment, Microorganisms, E. coli, Aerobic bacteria, Polymers, Gases, Oxygen, *Diffusion, Aqueous solutions, *Diffusion, *Growth rates, Respiration, Cultures.
Identifiers: Aerobacter aerogenes, Bacillus megaterium.

Unit processes in waste water treatment are dependent upon the satisfactory transfer of gases into and out of waste water for biological degradation of the organic matter. Any material that could increase transfer efficiency of gases would be of interest in waste water processes particularly activated sludge treatment. Studies of the diffusion of molecules of low molecular weight (such as gases) through dilute polymer solutions seemed to indicate that the rate of diffusivity was greater in aqueous polymeric solution than in pure solvent (water). The effect of a long chain synthetic polymer was studied in relationship to growth and respiration rates using three test organisms. Growth was measured quantitatively in the presence of different concentrations of polymer and compared to growth in the absence of polymer. A closed system using an electronic dissolved oxygen analyzer capable of measuring oxygen in parts-per-billion was used to study respiration rates in the presence of polymer.
W69-00646

ELECTRODIALYSIS IN ADVANCED WASTE TREATMENT,
U S Department of the Interior, Federal Water Pollution Control Administration.
J. Douglas Smith, and John L. Eisenmann.
Water Pollut Contr Res Ser Pub No WP-20-AWTR-18, 219 p, Feb 1967. 32 fig, 28 tab, 19 ref, 5 append.

Descriptors: *Tertiary treatment, *Electrodialysis, *Laboratory tests, Liquid wastes, Water reuse, Membrane processes, Solvent extractions, Scaling, Cost analysis.
Identifiers: *Advanced waste treatment, Carbon adsorption, Secondary effluent, Deionization.

A bench-scale experimental study was made to determine the practicality of partially demineralizing municipal wastewater by electrodialysis. Using filtration alone and filtration followed by carbon adsorption as pretreatments, long-term runs were made with a municipal secondary effluent to determine scaling and fouling effects of the water upon the electrodialysis membranes. During these runs a study was made to determine how high a ratio of product rate to concentrate rate could be obtained without forming scale on the membranes. Some fouling of anion membranes occurred with filtration and carbon adsorption pretreatment; without carbon adsorption, fouling was much worse. Scale formation was not a problem at product to concentrate ratios less than ten. At times much higher ratios were obtained without difficulty. The results of these runs indicated that the total operating cost for a 10-mgd electrodialysis treatment plant might be less than 10 cents per 1,000 gal. (Knapp-USGS)
W69-00691

5E. Ultimate Disposal of Wastes

CURRENT SEPTIC TANK SYSTEM INSTALLATION PRACTICES IN CONNECTICUT,
Connecticut Univ., Storrs.
J. J. Kolega, W. C. Wheeler, and G. W. Hawkins, Jr.
J Water Pollut Control Federation, Vol 38, No 10, pp 1592-1600, Oct 1966. 9 p, 6 tab, 9 ref. OWRR Project A-001-Conn.

Descriptors: Construction, Installation, *Septic tanks, Housing, Water pollution, Domestic wastes, *Sewage disposal, Sewage, Sewage effluents, Sewage treatment, Standards, Pollution abatement, Sanitary engineering, Soil disposal fields, *Connecticut.

A survey made by the Agricultural Engineering Department at the University of Connecticut of 195 installers of individual household sewage disposal systems evaluates, in terms of the Connecticut State Department of Health Sanitary Code, the domestic sanitation systems being installed in the State. The many inconsistencies which exist points out a need for strengthening of adherence to the State Code. Installation practices are reported and problems cited. Several approaches to strengthening the enforcement of proper sewage sanitation practices are given.
W69-00653

5F. Water Treatment and Quality Alteration

FACTORS AFFECTING THE REMOVAL OF IRON AND MANGANESE FROM GROUND WATER,
Mississippi State Univ., State College, Water Resour Res Inst.
L. R. Robinson, Jr., E. D. Breland, and R. A. Dixon.
Miss State Univ, 1967. 78 p, 5 fig, 23 tab, 22 ref, append. OWRR Proj A-003-Miss.

Descriptors: *Iron, Manganese, Groundwater, Separation techniques, *Water treatment, Waste treatment, Filtration, Alkalinity, Chemical analysis, Mississippi, Alabama, pH.

By using both a pilot treatment plant and a jar test apparatus, studies were made of factors affecting oxidation and precipitation of iron and manganese from ground waters in Mississippi and Alabama. Aeration alone was insufficient to oxidize and remove iron from waters with alkalinities of less than 50 mg/1 as calcium carbonate. Aeration was also insufficient to oxidize and precipitate manganese from ground waters with pH values of less than 9.0. Additional testing indicated that iron could be successfully removed by the processes of aeration, reaction time, and filtration, if the alkalinity was raised to at least 100 mg/1 as calcium carbonate prior to aeration by adding soda ash, lime, or caustic soda. Manganese could also be removed by raising the pH to 9.0 or preferably to 9.5 with lime or caustic soda. Potassium permanganate also successfully oxidized, precipitated, and removed iron and manganese. It presented the additional advantage that it did not greatly affect the water stability and thus necessitate further treatment. It also proved to be the most economical method from a chemical standpoint.
W69-00447

RADIOACTIVE DECONTAMINATION BY SLURRYING WITH YAZOO AND ZILPHA CLAYS,
Mississippi State Univ., State College.
William A. Goldsmith, and E. J. Middlebrooks.
Reprint, J Amer Water Works Ass, Vol 58, No 8, pp 1052-1062, Aug 1966. 11 p, 8 fig, 2 tab, 18 ref. OWRR Proj. A-004-Miss.

Descriptors: Water supply, Radioactivity, Water treatment, *Slurries, Water pollution treatment, Ion exchange, pH, Adsorption, Clays, *Radioactive wastes, Nuclear wastes, *Radioactive waste disposal, Radioisotopes.

The report covers decontamination of radionuclide-polluted waters using clay slurries. The literature on radioisotope removal is briefly reviewed. The paper discusses effect of pH and ion adsorption by clays. Test results are given on removal of Cobolt 60, Strontium 90, and Cesium 137 using Yazoo and Zilpha clays. Zilpha clay was superior to Yazoo as an adsorber of Strontium 90. Both Yazoo and Zilpha clays provided very good removal of Cesium 137, approximately 90% at a dosage of only 250/mg/1. Decontamination factors and percentage removals obtained for clay dosages used, except for Yazoo clay for Strontium 90, exceeded values obtained from comparable experiments involving other clays reported in literature. These encouraging results indicate that Yazoo and Zilpha clays may prove to be economically more feasible than the clays now used commercially.
W69-00448

THE ACCEPTABILITY OF MINERAL TASTE IN DOMESTIC WATER,
California Univ., Berkeley, Public Health Sch.
Andie L. Knutson, and William H. Bruvold.
Water Resour Res Center, Univ Calif, Rep W107-1A-67, July 1967. 10 p, 2 fig, 1 tab, 12 ref. OWRR Project A-005-Cal.

Descriptors: *Standards, Water quality, *Mineral water, Domestic water, *Potable water, *Taste, Attitudes, Dissolved solids, Consumptive use.

This report describes research designed to recommend limiting standards for common mineral content in domestic water in order to assure potability for daily drinking. A near linear relationship was found to exist between mean consumer attitude taste scale scores and a measure of total dissolved solids for 17 selected California water systems. The line so determined had a negative slope, the higher the total dissolved solids the less favorable the mean attitude scale scores. Use of the information provided by this relationship to recommend the desired standards upon full completion of the project was discussed.
W69-00656

5G. Water Quality Control

THE DISTRIBUTION AND PERSISTENCE OF DIAZINON APPLIED TO PLANT AND SOIL AND ITS INFLUENCE ON RHIZOSPHERE AND SOIL MICROFLORA,
Institute of Agricultural and Industrial Microbiology, Amherst and the Cranberry Experiment Station, East Wareham, Mass.
H. B. Gunner, B. M. Zuckerman, and R. W. Walker.
OWRR Project A-010-Mass, Plant and Soil, Vol 25, No 2, pp 249-264, 1966. 16 p, 5 fig, 4 tab, 10 ref.

Descriptors: *Diazinon, Insecticides, Pesticides, Planta, Rhizosphere, Soil microbiology, Degradation (Decomposition), Translocation.

Evidence was obtained of the rapid translocation of radioactive Diazinon through bean plants and its emergence in bean root exudates maintained under sterile conditions. Diazinon applied at the rate of 3 lbs per acre to soil under non-sterile conditions persisted for as long as 180 days after application. No Diazinon was detectable after 10 wks in soil receiving 0.3 lbs per acre. Diazinon or its degradation products exerted a selective effect common to both soil and rhizosphere microflora which expressed itself in the selective enrichment of a cocoidal rod. After 180 days a large number of the genus Streptomyces appeared as a seeming climax population. The predominant microbial isolate utilized Diazinon as a sulfur, phosphorus, carbon and nitrogen source in that order of preference.
W69-00414

A COST-BENEFIT ANALYSIS OF MINE DRAINAGE,
Ohio State Univ, Columbus.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00426

REPORT OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, TO ACCOMPANY S 2670, P 12-53.

Federal Water Pollution Control Act Amendments of 1967 -- 90th Congress, 1st Session, Senate Report No 917, Dec 11, 1967. 42p.

Descriptors: *Legislation, *Grants, Acid mine water, Mine wastes, *Oily water, Water pollution, *Lakes, Projects, Research and development, Model studies, Water pollution control.
Identifiers: Demonstration projects.

The Report discusses the major provisions of S 2760, including the reasons for them and their effect. It also includes a section-by-section analysis of the bill. A new and specific demonstration and research program dealing with both natural and man-made lake pollution is authorized. Projects are also authorized which will demonstrate techniques of controlling or eliminating acid or other mine water pollution. Projects demonstrating control or elimination of such pollution are also directed to be undertaken for entire watersheds or drainage areas. Implementation guildlines are set out. The Bill repeals the Oil Pollution Act of 1924, and adds a new section to the FWPCA, incorporating many provisions of the old Oil Pollution Act. The new section removes the necessity that a discharge be 'grossly negligent or willful' to violate the Act, and expands coverage to include shore installations. Persons who discharge oil are required to remove it immediately or pay all costs of clean-up. A revolving fund is established to enable the Secretary to take immediate action to avoid serious oil pollution. The FWPCA, with amendments contained in the Bill, is included. (R. F. Williams-Fla)
W69-00491

REPORT OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, TO ACCOMPANY S 2760, P 1-11.

Federal Water Pollution Control Act Ammendments of 1967 -- 90th Congress, 1st Session, Senate Report No 917, Dec 11, 1967. 11p.

Descriptors: *Legislation, *Acid mine water, Coal mine wastes, Mine wastes, *Oily water, Water pollution, Political aspects, *Lakes, Project planning, Research and development, Eutrophication, Waste assimilative capacity.

S2760 is an omnibus water pollution bill, which consolidates the provisions of several other bills relating to lake pollution, oil pollution, and drainage pollution from mines, and which amends the Federal Water Pollution Control Act accordingly. The lack of federal legislation concerning lake pollution, special problems of lake pollution, lack of knowledge in this area, and potential solutions are discussed. Since lakes lack the flushing action of running water, their problems differ from those of rivers. Lake eutrophication, or natural deterioration, is accelerated by pollution. Acid and other mine drainage pollution is discussed next. Acid from mines seriously upsets the biological balance in streams and this problem is compounded by the fact that most such pollution comes from abandoned mines. Techniques of abatement of mine drainage pollution are discussed. Oil pollution, and serious cases thereof are next discussed. Oil pollution is usually incedent to the transportation of oil, and is caused by accidents, poor maintenance, carelessness, etc. The Oil Pollution Act of 1924 was found to be inadequate to cover these problems. (R. F. Williams-Fla)
W69-00492

NEW YORK POLLUTION CONTROL POLICY AND LAKE ERIE,
Anselmo F. Dappert.
Industrial Water and Wastes, Vol 9, No 1, pp 29-31, Jan-Feb 1964. 3 p.

Descriptors: New York, *Water pollution control, Neutralization, Sewage treatment, Waste water treatment, *Lake Erie, Taste, Water pollution effects, Acidity, Odor, Domestic wastes, Industrial wastes, Sewage effluents, Silts, Sewage disposal, Legislation, Water law, State governments.

The New York State water pollution control program is based on the concept that all waters which receive or are to receive waste discharges of any kind shall be protected to the extent necessary for the various usages which are officially recognized for such waters. The official recognition of these usages is preceded by a series of steps leading to classification and assignment of quality standards to all waters in the state-fresh surface waters, tidal salt waters and ground waters. Basically, for discharges into Lake Erie waters the policy is to consider each problem in relation to the particular circumstances and the actual or anticipated lake classifications. (R. Smith-Fla)
W69-00495

LEGISLATING CLEAN WATER,
Portia Law School, Beacon Hill, Boston, Mass.
J. R. Flood.
Portia L J, Vol 3, No 1, p 39-43, Fall 1967. 5 p, 9 ref.

Descriptors: *Federal government, *Legislation, *Water pollution, State government, Legal aspects, Social aspects.
Identifiers: Water Pollution Control Act, Water Pollution Control Admin.

The article outlines the history of federal legislation dealing with water pollution. It deals briefly with the acts from the Refuse Act of 1899 to the Water Quality Act of 1965. State legislation is referred to as parallelling the activities of the federal government. The author points out that with the increasing emphasis being placed on water-rights law the common law that has served reasonably well in the past will have to be replaced by new studies, new interpretations and new statutes. (Horner-Fla)
W69-00499

SOUTHEASTERN COMPREHENSIVE PROJECT FOR WATER POLLUTION CONTROL.
Federal Water Pollution Control Admin., Washington, D. C.

Southeastern Comprehensive Project for Water Pollution Control pp 1-12, June 1966. 13 p, 9 photo.

Descriptors: *Federal government, *Water pollution control, Water pollution, *Southeastern U S, River basin development, Legislation, Water quality.

The purpose of this pamphlet is to give an overview of the programs that the federal government has instituted for the Southeastern States in the field of water pollution control. For example, the Federal Water Pollution Control Act of 1956 orders that scientific programs to insure the availability of clean water be developed for all major river basins. The geography and growth of the Southeastern Basin are set forth. Examples of shortcomings in present pollution control measures are given. For example, one third of the municipal sewer systems in the area provide for no treatment whatsoever, and another third provide primary treatment only. Goals are set forth for federal programs, the first being to assist communities in building at least minimum waste treatment facilities and operating them effectively. Present activities of the staff of the Southeastern Comprehensive Project for Water Pollution Control are presented. (Patterson-Fla)
W69-00505

FLORIDA AIR AND WATER POLLUTION ACT.
Fla Stat 403 (1967).

Descriptors: *Florida, *Legislation, *Water pollution, Air pollution, Costs, *Pollution abatement, Permits, Local governments, Recreation, Domestic water, Wastes, Damages, Inspection, Water resources development, Planning, Public health.

This act creates the Florida Air and Water Pollution Control Commission and gives it authority to abate pollution and conserve the waters of the State for domestic, agricultural, industrial, recreational, and other beneficial uses. He sets out enforcement procedures and sets penalties for noncompliance with the Act. It authorizes local governments to establish pollution control programs consistent with the Act. It authorizes variances from the Act upon approval by the Control Commission for the following reasons: (1) There is no practicable means of controlling the pollution involved; (2) Enforcement of the Act would necessitate an unreasonable cost to the individual or corporation concerned; and (3) To relieve or prevent hardship different in kind from (1) or (2) above. The Act sets the tax base of water pollution equipment at its salvage value. The Act allows the state to recover civil damages for pollution of public waters. (Crabtree-Fla)
W69-00509

REORGANIZATION PLAN NO 2 OF 1966 (WATER POLLUTION CONTROL).
U. S. Congress, House Committee on Government Operations, 89th Congress, 2nd Session.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00516

AN ACT RELATING TO THE WATER AND AIR ENVIRONMENTAL IMPROVEMENT COMMISSION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00518

AN INTERSTATE APPROACH TO WATER POLLUTION ABATEMENT,
Thomas R. Glenn.
Chemical Engineering Progress Symposium Series, Vol 59, No 45, pp 11-14, 1963. 4 p, 1 map.

Descriptors: *Pollution abatement, Water pollution, Water pollution control, Biochemical oxygen demand, Pollutant identification, Public health, Standards, Water pollution treatment, Water quality control, *Domestic wastes, *Industrial wastes, Municipal wastes, Sewage, Sewage effluents, Wastes, Shellfish, Recreation, Water law.

The Interstate Sanitation Commission was created by compact or treaty between New York, New Jersey, and Connecticut for the abatement of existing water pollution and the control of future pollution in the waters of the New York metropolitan area. The Compact recognizes that because of the varied uses of water for bathing, navigation, shellfish culture, fishing, and the disposal of wastes, no single standard of purity is economically practical. Accordingly the waters are divided into two classes: class A - water is expected to be used primarily for recreational purposes; class B - water used for other purposes. The Commission has expended its greatest effort in obtaining the treatment of domestic waste, since this is the source of pathogenic diseases. The jurisdiction of the Commission covers only estuarial and tidal waters and a number of problems not encountered in non-tidal pollution abatement work must be solved. Considerable progress has been made since the Commission was created in 1936, primarily because of the cooperation of many agencies, particularly those charged with pollution control in each of the three member states. (Smith-Fla)
W69-00519

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00528

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00529

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00530

LINDANE ADSORPTION BY LAKE SEDIMENTS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00621

CRUSHED LIMESTONE BARRIERS: A BASIC FEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS,
Pennsylvania State Univ., University Park.
Robert E. Jarrett, and R. Rupert Kountz.
OWRR Project A-002-Pa. Water Resour Res Publ 2-66, June 1966. 112 p, 13 fig, 8 tab, 5 append.

Descriptors: *Neutralization, *Acid streams, Stream improvement, Hydraulic properties, Calcium carbonate, *Limestones, Hydraulic structures.
Identifiers: Mineral acidity.

In a hypothetical stream a crushed limestone barrier 5 ft deep and 100 ft long seemed capable of successfully neutralizing mineral acidity stemming from sulfuritic minerals when little iron and no silting were present. This basic feasibility study investigated the principle reaction between sulfuric acid and limestone and formulated a barrier design procedure. The relationship between rate of neutralization, mineral acid concentration, fluid velocity, stone size, and head loss was established so further research may develop an inexpensive neutralization method for small streams. The hydraulic properties of crushed limestone were determined; a computational procedure was developed to apply the data for designing barriers. This preliminary engineering data search to satisfy hydraulic and chemical processes simultaneously also determined a shape factor for calculating estimated head loss at different fluid velocities in beds of differently sized particles; and studied the 'overall reaction rate' under various mineral acidity, fluid velocity, and stone size conditions. (Sink-Pa State)
W69-00637

PERSISTENCE OF RESIDUES AND FATES OF HERBICIDES IN RICE FIELDS AND IN RICE FIELD EFFLUENTS,
California Univ., Davis, Botany Dept.
F. M. Ashton.
Final Rep, Water Resources Ctr, 1967. 4 p, 13 ref. OWRR Project A-013-Cal.

Descriptors: *Rice, *Herbicides, Effluents, Weed control, Aquatic weed control, Pesticide residues, Pesticides.
Identifiers: *Rice fields.

Investigations were undertaken to determine residue levels and persistence of herbicides in ricefield waters, determine fates of herbicides in ricefield plants, and develop improved, safe, and effective chemical weed control procedures for rice. Over 65 new herbicides were evaluated for possible use in control of submersed weeds in rice. Of these, formulations of MDMA-endothall, 06K, chloroxuron, and a copper salt of endothall (TD-294) gave outstanding selective weed control in small scale tests, and all but TD-294 performed well in large scale trials. Aerial applications of granular 06K resulted in such good weed control that rice yield increases of 20 and 40% were obtained in 2 separate fields infested with Chara sp. Information contributed by the molinate study has clarified understanding of the action and fate of this new kind of herbicide and should be very useful in further development for rice growing areas.
W69-00669

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

OPTIMAL AERATION SYSTEMS,
Kansas State University, Manhattan.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-00408

A MATHEMATICAL MODEL FOR SIMULATING THE HYDROLOGIC RESPONSE OF A WATERSHED,
Purdue Univ, Lafayette, Ind.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00568

THE MEKONG DELTA MODEL,
SOGREAH, Grenoble, France.
Henri Lorgere.
Sci J, Vol 4, No 7, pp 70-75, July 1968. 6 p, 5 fig, 2 ref.

Descriptors: Deltas, Mathematical analysis, Flood, Project planning, Flood damages, Computer programming, Reservoir operation, Flood routing, *Flood control, *Simulation, *River regulation, Rivers, Navigation, Land reclamation, Flood plains.
Identifiers: *Mekong Delta, Mekong River Project, Mathematical models, *Tonle Sap Project, Cambodia.

The Mekong River was dammed by computer simulation on one of the world's largest mathematical models. The computer study, financed by Cambodia, Vietnam, and the United Nations Special Fund, was performed by SOGREAH, took 4 yr, and cost 450,000 pounds. Results showed that the dam would bring important economic benefits to the delta area. Annual flooding in the plains of Cambodia and South Vietnam would be reduced by a proposed dam on the Tonle Sap River, a major tributary of the Mekong. Flood damage to rice crops, towns, roads, and bridges would be lessened; more land would become available for agriculture; and the water supply during the dry season would be increased, benefiting irrigation, navigation, and salinity abatement. The method used for constructing the mathematical model and problem solutions are described. (USBR)
W69-00592

OPTIMIZATION OF THE OPERATION OF A MULTIPLE-PURPOSE RESERVOIR BY DYNAMIC PROGRAMMING,
California Univ, Los Angeles.
Warren A. Hall, William S. Butcher, and Austin Esogbue.
Water Resour Res, Vol 4, No 3, pp 471-477, June 1968. 7 p, 3 fig, 4 ref.

Descriptors: *Optimum use, *Reservoir operation, Hydroelectric power, Multiple purpose projects, Reservoirs, Hydrology, Computer programming, Hydrologic data, Runoff forecasting, Mathematical analysis, Streamflow records, Water storage, Outflows, Storage, Programs.
Identifiers: *Optimization, *Dynamic programming, Mathematical models, Inflow, Firm energy, Shasta Dam, Calif.

The dynamic operation policies for planning complex reservoir systems that produce hydroelectric power and provide water can be optimized for the maximum return from firm water and power and dump water and power. The technique provides for complex constraints such as: (1) mandatory flood control reservations that are variable in time; (2) fish, wildlife, and recreational releases; and (3) navigation minimum flows, evaporation losses, and interbasin diversions. The paper presents the operational analysis of a component reservoir-river system and the procedure used to combine optimally a number of such subsystems into a coordinated, mutually reinforcing, multiple-river system. To ensure the essential practicality of the procedure, the analysis is based on the physical and hydrological characteristics of Shasta Dam, Shasta Lake, and Keswick afterbay on the Sacramento River in Calif. (USBR)
W69-00596

THE OPTIMIZATION OF LARGE SCALE WATER RESOURCE SYSTEMS: OPERA-

TIONAL ASPECTS, PART I: CONCEPTUAL FRAMEWORK,
California Univ., Berkeley, Operations Research Center.
Nathan Buras.
Rep, Univ Calif, Sept 1965. 42 p, 8 fig, 8 ref. OWRR Project A-019-Cal.

Descriptors: *Water resources, Multiple-purpose projects, *Optimum development plans, Municipal water, Industrial water, Irrigation water, Hydroelectric power, Hydrologic data, Inflow, Evaporation, Dynamic programming, Water storage, *Optimization, Linear programming, Water utilization, Mathematical studies.

A water resource system consisting of 4 reservoirs was analyzed with respect to operation in an integrated manner. The reservoirs release water for irrigation, municipal, and industrial uses, and for the generation of hydroelectric power. Requirements are to: (1) determine the maximum amount of firm water and firm power which may be produced by the system, and (2) determine an optimal operating procedure for the satisfaction of the target outputs determined above. Only part (1) is discussed. Optimization of the entire system using dynamic programming was found to be unfeasible due to the large dimensionality of the problem: at least 1 dimension for each reservoir of subsystem. Consequently, the decomposition principle was applied using a combination of dynamic programming (for the optimization of each subsystem) and linear programming (for the optimization of the master program). Hydrological data covering 10 consecutive years and including lowest inflows on record were supplied so that 10 different values of firm water and firm power may be calculated. On that basis of these results, the target outputs for the system as a whole, in terms of firm water and firm power, may be determined.
W69-00658

6B. Evaluation Process

URBAN ENVIRONMENTAL PROBLEMS,
Univ. of Florida, Gainesville.
R. Albertson.
Eng Prog, Univ Fla, Vol XXI, No 6, Bull 128, June 1967. 98 p, 3 fig, 165 ref. OWRR Project A-999-Fla.

Descriptors: River systems, Abatement, *Federal government, *Natural resources, Institutional constraints, Mathematical studies, *Water law, Transportation, Water policy, Cost analysis, Eminent domain, Riparian rights, *Recreation, *Social aspects, *Environment, *Cities.

Reshaping and properly managing the urban environment poses one of the great challenges to contemporary society. Whether this challenge will be met effectively depends, in part, upon the development of channels of communication and the development of action programs among a wide spectrum of disciplines including law, sociology, regional planning, economics, environmental engineering and political science. Unidesciplinary confrontations with the urban challenge are doomed to failure. Under the umbrella of the University of Florida Water Resources Research Center, Professor E. E. Pyatt organized a graduate seminar, 'Urban Environmental Problems,' which was presented during the Spring Trimester, 1966. The keynote speaker was Dr. Allen V. Kneese of Resources for the Future, Inc, with subsequent presentations by University of Florida faculty from a wide array of departments and colleges. The collected papers, dealing with the economic, legal, political and geographic aspects of the urban environment constitute the content of the subject publication.
W69-00401

WATER RESOURCES AND RELATED PROBLEMS IN THE APPALACHIAN REGION OF GEORGIA,
C. E. Kindsvater.
1st Meeting Water Develop Coord Comm, Asheville, Sep 1965. 8 p. OWRR Project A-999-Ga.

Descriptors: *Water resources, *Georgia, Hydrology, Groundwater, Natural resources, Rivers, Springs, Precipitation (Atmospheric), River basin development, Water supply, Water quality, Flood control, Wildlife, Watershed management, Hydroelectric power, Recreation.
Identifiers: Chattachoochee Riv, Ga, Tennessee River, *Appalachian Region, Ga.

This review of water resources and water problems of the Appalachian region of Georgia reveals general areas of need and opportunities for water development and control. The research on which it was based revealed inadequacies in: (1) basic data, (2) technology, (3) coordinated planning and development. These are not unique nor regional problems, but it is hoped that the work begun on this action program for Appalachia will focus attention on the basic need to plan comprehensively for the optimum utilization for all our national resources.
W69-00402

SOCIAL IMPACT OF METEOROLOGICAL DROUGHT IN ILLINOIS,
Illinois Univ, Urbana. Water Resour Center.
Alfred W. Booth, and Don Voeller.
Res Rep 9, Univ Illinois, Mar 1967. 31 p, 12 ref. OWRR Project A-007-Ill.

Descriptors: *Droughts, *Illinois, *Social aspects, Social adjustment, Psychological aspects, Water supply.
Identifiers: Palmer index.

Drought invariably infers a shortage of moisture in one context or another. Attempts have been made to develop a procedure whereby the relative and absolute impact of this phenomenon can be measured. It was proposed to test the validity of meteorological drought, as defined by the recently derived Palmer Index, by comparing the variability of drought in Illinois with the effects of this phenomenon on various sectors of the State's society. Research was based on the hypothesis that the impact of drought on the social realm varies as drought severity varies. Due primarily to lack of long-term, readily available data and developed methodology for isolating effects of natural phenomenon on man, little conclusive objective evidence was obtained; however, drought has a variable impact: (1) from one sector of society to another at a given time, (2) within the same sector of society in given areas at a given time, (3) in given sectors of society through space, and (4) through time on society as a whole, all because of the nature of man's culture enables him to better cope with the vagaries of nature on one hand and results in his becoming more susceptible to them on the other.
W69-00405

A BENEFIT-COST ANALYSIS OF LOCAL WATER SUPPLY,
Wisconsin Univ, Madison.
W. J. Stober, and L. H. Falk.
OWRR Project B-001-La, Land Economics, Vol 53, No 3, pp 328-335, Aug 1967. 8 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Capital costs, *Cost comparisons, Cost-benefit analysis, *Cost-benefit theory, Depreciation, Diseconomies of scale, *Discount rate, Return to scale, Tax rate, Unit costs, Taxes, *Water supply systems, Investment, *Benefit-cost ratios, *Water supplies, Louisiana, Local governments.

Communities facing an industrial-municipal water shortage have 2 broad courses: either private or public financing of water replacement projects. Whether a communit could supply water at a lower cost can be decided by a benefit-cost analysis (differing from analyses for federal projects). The annual benefit from a community project is the present value of the annual cost savings that would result from the nonundertaking of the privately financed alternatives. The average annual cost to the community is the annual net cash outlay for the purchase of water from the community project at a price just sufficient to cover the project costs. The cost of private alternatives is discounted by the corporate costs of capital; the cost of the community project, by the community's costs of capital. A direct consequence of the corporate income tax structure is that the benefit-cost ratio will always be greater than unity if the returns to scale are constant and if both the community and corporate costs are discounted at the same interest rate. A numerical example based on the corporate tax structure in Louisiana demonstrates that a community-financed project, with its lower costs of capital, almost always will be more favorable than a private one.
W69-00410

A COST-BENEFIT ANALYSIS OF MINE DRAINAGE,
Ohio State Univ, Columbus.
Richard A. Tybout.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 334-371, May 1968. 37 p, 15 tab, 14 ref.

Descriptors: *Acid mine water, *Mine drainage, *Water pollution treatment, *Cost-benefit analysis, *Regression analysis, Pennsylvania, Water quality control, Taxes, Assessments, Non-structural alternatives, Standards.
Identifiers: OWRR-grant study, Stream quality.

Costs of abatement of acid mine drainage for coal mines in Pennsylvania are calculated and classified by county. Estimates are based on statistical analysis of the data from the Pennsylvania Dept. of Mines and Mineral Industries' Yellowboy Project. The volume of mine drainage is analyzed as a function of historic patterns of coal production, methods of mining, seam thickness, and hydrologic conditions. Costs are estimated for other areas of Appalachia by comparison with Pennsylvania costs. Secondary costs of unemployment caused by closing of mines for failure to treat waste satisfactorily are also estimated. Benefits are not evaluated. The suggestion is made that in many cases treatment cost is greater than benefit and polluters in such cases should pay downstream users for damages as an alternative to treatment. Annual treatment cost estimates for all Pennsylvania active mines are tabulated. The cost of sealing inactive mines is estimated to be $18-36 million. Tables include treatment plant cost estimates, Yellowboy cost regressions and cost functions, number of draining mines by counties, volume of drainage by counties, average thickness of coal seams, correlation matrix for underground and strip mines, drainage volume regressions, and quality of drainage. (Knapp-USGS)
W69-00426

NAVASOTA RIVER WATERSHED, TEXAS (BASIN DEVELOPMENT STUDY REPORT).
Army Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00442

WATER RESOURCES PROBLEMS AND RESEARCH NEEDS OF NORTH CAROLINA,
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
David H. Howells.
Rep 2, Mar 1967. 53 p, 1 map, 2 append. OWRR Proj A-999-NC.

Descriptors: *Water resources, Conservation, Planning, Quality control, Groundwater, Surface waters, *Research and development, *North Carolina.

This summary of North Carolina's water resources problems and research needs serves as the basis for the Water Resources Research Institute's research program. Subject matter is presented within the four broad categories of water resources planning, water conservation, water quantity management, and water quality management. Attention is given to all currently recognized problems and research needs are identified where additional research will contribute to solutions of these problems. The 63 research needs identified in report are summarized in the appendix by research category and relative priority.
W69-00459

ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES,
Resources for the Future.
Irving K. Fox, and Orris C. Herfindahl.
American Economic Review, march, 1964, p 198-206, 20 ref.

Descriptors: *Administrative agencies, Local governments, Benefit-cost analysis, Project evaluation, Federal project policy, Investment, Project planning, Institutional constraints, *Inter-agency cooperation, Optimum development, Plans, Water resources development, *Federal jurisdiction, Pricing, Adoption of practices.

An assessment of the results of existing practices within the federal government upon efficiency is done by examining certain key federal policies which bear on efficiency. One of the most important is that the beneficiaries of a federal water investment project bear only a small portion of the costs. The federal agency involved allies itself with local organizations representing those who will benefit. These interests then dominate the investment decision; what can result is inefficiency resulting from optimistic estimates of benefits and the neglect of cheaper alternatives because most of the pressures are in one direction. Another federal policy that can prove inefficient is the present method of benefit-cost analysis, without application of the marginality principle. Significant errors of concept that are made in evaluation of demand are also pointed out. Suggestions for further exploration of the production function are given as a means to increase efficiency of projects. The desireability of two modifications (1) place greater reliance upon charges and prices in allocation process (2) an independent audit of planning activities are discussed. In conclusion, it is deemed desirable to explore the value of alternative plans even if monetary values are not relevant. (Gargola-Chicago)
W69-00496

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
Colorado State Univ, Fort Collins.
Vujica Yevjevich.
Water Resour Res, Vol 4, No 2, pp 225-232, Apr 1968. 8 p.

Descriptors: *Hydrology, Flood, Forecasting, Ground water, Evaporation control, Climatology, Atmospheric precipitation, Water resources, Flood forecasting, Weather modification, Fluvial morphology, *Errors, Maximum probable flood, Cloud seeding.
Identifiers: Maximum rainfall, Stochastic models, Deterministic model, Risk.

Several misconceptions introduced into hydrology have had adverse consequences on the science and on water resources development. Persistent use of the concept of maximum precipitation and maximum probable precipitation, for which there is no physical proof, has discouraged research into the structure and probability of extreme events, and may have led to an unwarranted sense of security concerning flood control works. Attempts at long-range forecasts of water supply, based entirely on meteorological processes, have misdirected research and raised false expectations. A misconception that hydrologic processes are composed of a limited number of hidden periodicities has retarded the use of modern stochastic analyses of time series. Cloud-seeding to increase numbers of rainfrops rather than their coalescence may have had a negative effect on precipitation in arid regions. Considering ground water as the resource, instead of the aquifer, has stressed the technology of withdrawal at the expense of the study of recharge methods and has led to much unplanned overdraft of ground water. Using descriptive rather than numerical variables has delayed applying modern statistical methods to planning the exploration of the ground-water environment. (USBR)
W69-00580

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Walnut Creek, Calif; Washington Univ, Seattle.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00582

THE CALIFORNIA WATER PROJECT: IS PUBLIC DECISION MAKING BECOMING MORE EFFICIENT,
Washington Univ, Seattle.
Gardner Brown, Jr.
Water Resour Res, Vol 4, No 3, pp 463-470, June 1968. 8 p, 27 ref.

Descriptors: *Decision making, Projects, *Water development, Multiple purpose projects, *Economics, Project planning, *Water costs, Benefit-cost ratios, Interest (Finance), Capital costs, Cost comparisons, Water resources, Public utilities, Demineralization, Bibliographies, Policy matters, Efficiencies, Water supplies.
Identifiers: *California State Water Proj, California Water Plan, Bureau of Reclamation, Federal government, Evaluation.

The economic soundness of the Calif State Water plan is discussed and the extent to which the plan shows marked improvement over Federal water projects is shown. The study indicates why economists reach different conclusions. Using an incorrect discount rate, applying procedures that overestimate net benefits, and failing to charge a scarcity price for water are inappropriate arguments against the value of the Calif State Water Project. The existence of alternative public investment opportunities and technological progress in desalination are 2 factors to which the State may have given inadequate attention. Although the State's water pricing policy encourages more efficient resource allocation than that of the Federal government, plausible grounds exist for believing that further improvement is possible. (USBR)
W69-00595

FEASIBILITY OF WATER EXPORT,
Manitoba Univ, Winnipeg, Canada.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00601

AGRICULTURAL WATER CONSIDERATIONS IN DEVELOPING STATE WATER PLANS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00607

ORGANIZATIONAL ARRANGEMENTS FOR WATER DEVELOPMENT,
Resources for the Future and Department of Conservation, School of Natural Resources, University of Michigan.
Irving K. Fox, and Lyle E. Craine.
Natural Resources Journal, April 1962, 44 p, 51 ref.

Descriptors: Economies of scale, Government supports, Market value, Administrative decisions, Water resource development, Intangible costs, Attitudes, Project planning, *Administrative agencies, Adoption of practices, River basin development, *Coordination, Decision making, *Interagency cooperation, *Political aspects, Methodology, Water allocation policy, Motivation.
Identifiers: Welfare maximization.

An analytic structure is given, within which designs of institutional arrangements for water resource development can be formulated. This structure consists of four categories: (1) the requirement of the value system, which is welfare maximization, (2) characteristics of the function of producing water services, which are physical interdependencies, economies of scale, indivisibility of services, and benefits difficult to quantify, (3) integration of planning production facilities, operation of facilities, and distribution and marketing of services produced, (4) economic environment and governmental interrelationships. In light of these, existing U.S. organization for water resource development is reviewed and weaknesses of these arrangements discussed. Suggestions for improvement consist of: (1) application of 'market-like' forces, (3) special machinery to coordinate water policies to other related policies, and (4) machinery to assure presentation of alternatives to entire public. (Gargola-Chicago)
W69-00616

THE SIGNIFICANCE OF WATER RESOURCES AS AN ATTRACTION TO INDUSTRY IN THE TOWN CREEK WATERSHED,
Mississippi State Univ., State College.
Don C. Wilcox, William C. Flewellen, and Guy T. Peden.
Water Resour Res Inst Rep, June 1966. 111 p, 7 fig, 36 tab, 17 ref, 3 append. OWRR Project A-002-Miss.

Descriptors: Water resources, Watersheds, *Industrial water, Ground water, *Industrial plants, *Water management, Municipal water, Flood control, Surface water, Population growth, Economics, Mississippi, Bibliographies, Water resources development, *Industries, Economic impact.
Identifiers: Water use.

A study was conducted to determine the significance of water resources to industrial users in the Town Creek Watershed in northeast Mississippi a sub-basin of the Tombigbee River Basin. Ground and surface water conditions in the area, an analysis of current water usage in the watershed, and an evaluation of future uses and needs in the area were studied. Population, manufacturing employment, manufacturing wages, and municipal water customers were factors used to evaluate the relationship between future water needs and water management.
W69-00649

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M University, College Sta, Texas Agricultural Experiment Station.
Thomas J. Casbeer, and Warren L. Trock.
Technical Report No 1, Department of Agricultural Economics and Soc., Texas A and M University, pp 1-161, Aug 25, 1967. 161 p, 5 tab, 136 ref, 3 append.

Descriptors: *Resource development, *Water rights, *Political aspects, *Legal aspects, History, Drainage, Government.
Identifiers: Economics, *Institutions, Lower Rio Grande Valley.

This report studied the legal, political, cultural, and economic institutions and their impact on the water resource development of the lower Rio Grande Valley, Texas. Also studied were the history of

development and the water rights of the area. The methodology used consisted of the examination of the institutional arrangements important to the water development of the area. Through studies of past literature, past and present legislation on the national, state, and local levels, and personal interviews, the various factors were characterized. The study also included a climatic and geographical description of the area. It was found that the water supply is limited, the available supply is not being used efficiently, and that there is a severe drainage problem. It is assumed that if people realize that the value and productivity of their property is lowered by these properties, that the institutions will be altered so that corrective action will be taken. (Grossman-Rutgers)
W69-00676

ADJUSTED BENEFIT-COST RATIOS FOR SIX RECENT RECLAMATION PROJECTS,
Resources for the Future, Inc., and University of Washington.
Myrick A. Freeman, III.
Journal of Farm Economics, Vol 48, No 4, Part 1, pp 1002-1012, Nov 1966. 11 pp, 3 tab, 22 ref.

Descriptors: *Federal reclamation law, *Costs, Parity ratios, *Primary benefits, *Secondary benefits, Farm prices, Irrigation.
Identifiers: Economics, *Cost-benefit analysis, *Reclamation.

Six single-purpose projects of the Bureau of Reclamation are reviewed as to the validity of their benefit-cost estimates. The six projects are in Nebraska, Utah, Idaho, Wyoming, and Oregon. Where the benefit-cost estimates were found to be biased, adjustments were made. The estimates made by the Bureau were biased due to their use of a low discount rate, because they counted secondary benefits, and they were over optimistic in their price projections. Also, other sources of bias were not counting the opportunity cost of farm labor, and not counting the opportunity cost of water. The revised benefit-cost estimates are less than one for five of the six projects studied. The author compared estimated project construction costs with realized costs and found the Bureau's estimates to be favorable. (Grossman-Rutgers)
W69-00677

ECONOMIC CONSIDERATIONS IN FORMULATIONS OF NATURAL RESOURCE POLICIES,
Water Resources Council, Washington, D. C.
Harry A. Steele.
Journal of Farm Economics, Vol 48, No 5, pp 1232-1238, Dec. 1966. 7 p, 5 ref.

Descriptors: *Planning, Economic efficiency, *Project life, *Water Resources Planning Act, *Water Resources Council, Benefits, Water quality control.
Identifiers: Economics, Federal Government.

Three purposes of planning are the well-being of the people, economic development, and the preservation of the quality of environment. Plans should be formulated so that they will be comprehensive as to purpose and effects. The following criteria are to be considered in the initial formulation of a plan: tangible benefits should exceed tangible costs; each separable unit or purpose should provide benefits at least equal to its cost; scope of development should provide maximum net benefits; and, there should be no more economical means of accomplishing the same purpose. A second step would be to take account of the intangibles. The length of the project should not exceed 100 years. Current rates should be used. The economic considerations of the Water Resources Council are examined as are the various titles under the Water Resources Planning Act. Four opportunities for the improved application of economics to water resource planning are discussed. (Grossman-Rutgers)
W69-00679

ON THE QUANTITATIVE INVENTORY OF THE RIVERSCAPE,
U S Geological Survey, Washington, D. C., Water Resources Division.
Luna B. Leopold, and Maura O'Brien Marchand.
Water Resources Res, Vol 4, No 4, pp 709-717, Aug 1968. 8 p, 5 tab, 8 ref.

Descriptors: *Aesthetics, *Scenery, *Valleys, California, River basin development, Recreation, Conservation, Watershed management.
Identifiers: *Riverscape inventory, Sampling problems, Scarcity evaluations, Scenic misfits.

In the Berkeley, California area, 24 minor valleys were described numerically in terms of factors comprising social or aesthetic values chosen to represent aspects of riverscape. At each site 28 factors were evaluated. Some were directly measurable, others were estimated, but each observation was assigned to one of five categories for the factor. Each factor for each site was then expressed as a uniqueness ratio, which depended on the number of sites being in the same category. The uniqueness ratio is believed to represent one way in which the scarcity of a given riverscape can be ranked quantitatively without bias based on notions of good or bad, and without assigning monetary value. It is suggested that a classification of scarcity is feasible that can lead to a technique for river survey adaptable in a basic data program in addition to the usual hydraulic and hydrologic factors. Scarcity evaluations might be applied in making choices among alternatives in river basin development. quifer divided by its effective porosity. The distribution coefficient for an ideal tracer is zero; the average velocity of this tracer is equal to the average groundwater velocity. (Knapp-USGS)
W69-00702

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ESTIMATING COST OF GROUND-WATER WITHDRAWAL FOR RIVER BASIN PLANNING,
U S Geological Survey, Water Resources Division.
Este F. Hollyday, and Paul R. Seaber.
Ground Water, Vol 6, No 4, pp 15-23, July-Aug 1968. 9 p, 7 fig, 3 tab, 13 ref.

Descriptors: *Groundwater, *Withdrawal, *Cost comparisons, *Water yield, Unit costs, Specific capacity.
Identifiers: *Cost of groundwater, Potential yield, Susquehanna River basin.

Groundwater costs were estimated in comprehensive planning of water resources development including appraisal of alternative sources of supply in the Susquehanna River BASIN. Log-normal plots on log-probability paper of specific capacities adjusted to 180 days of pumping were used to estimate yields of 65 aquifers. The estimated yields at the 25, 50, and 75% probability levels were obtained using hypothetical well design and selected drawdowns. Unit water costs were calculated from well construction, electrical power, and maintenance costs, all from standard sources. Estimated water costs range from $0.11 per 1.000 gal at 15 gpm to $0.004 per 1,000 gal at 9,000 gpm. A yield of 50 gpm costs $0.060 in shale or interbedded sandstone and shale, and $0.050 in metamorphic rock. A yield of 100 gpm costs $0.043 in shale and interbedded sandstone, and $0.032 in carbonates. A yield of 500 gpm costs $0.020 in sandstone, $0.015 in carbonates, and $0.012 in clacial sand and gravel. A yield of 1,00 gpm costs $0.009 in glacial sand and gravel. Cost differences are caused mainly by differences in pumping levels. (Knapp-USGS)
W69-00436

AUGUSTA POWER CO V US (COST REPAYMENT FOR FLOWAGE EASEMENT).

278 F 2d 1-5 (5th Cir 1960).

Descriptors: *Judicial decisions, *Easements, Eminent domain, Cost repayment, *Compensation, *Land appraisal, Condemnation value.
Identifiers: Flowage easements.

U S (defendant here) filed notice of civil condemnation proceedings with Augusta Power (plaintiff) on lands over which plaintiff held flowage easements. Commissioners found that the criterion for dividing the value of the land in compensating the owners of the fee and plaintiff's flowage easements was the difference in the value of the land with and without the flowage easement. This method for fixing the compensation was approved by the US District Court for the Southern District of Georgia. Both parties appealed. The US contended that, without a showing by the plaintiff, that it ever intended to use the easements, no compensation should be paid for their taking. Augusta Power contended conversely that the compensation determined was not enough. This court reversed, holding that the standard used by the commissioners was erroneous. While a flowage easement doubtless lessens the value of the fee-owner's interest, it does not necessarily follow that the amount of such decrease and the value of the flowage easement to its owner is identical. The maximum compensation payable for such easements is so much of the useful value of such lands as the easement owner has a right to destroy or depreciate. The actual measure of the compensation being the practical value of the easement to its owner. (Blunt-Fla)
W69-00469

BOARD OF PUBLIC INSTRUCTION V LITTLE RIVER VALLEY DRAINAGE DIST (UNENFORCEABLE RIGHTS AGAINST THE STATE).

119 So 2d 323-327 (3 Dist Ct App Fla 1960).

Descriptors: Florida, *Judicial decisions, Drainage districts, *Taxes, Financing, Legislation, *Debt, Land tenure, Public lands, State governments, *Schools (Education).
Identifiers: Constitutional law.

The Board of Public Instruction of Dade County sought a declaration of non-liability, to have certificates declared null and void and an injunction against the issuance of tax deeds against holders of outstanding tax sale certificates issued for nonpayment of drainage district special assessments for benefits. The District Court of Appeal, reversing, held that where the Legislature had not authorized the Board to pay special assessments for drainage district benefits, liens and tax sale certificates based on nonpayment of the assessments were not enforceable against the property and tax deeds could not be issued. Article 12 of the Florida Constitution controls the use of funds of the Board of Public Instruction and here leaves the defendants with what the court admits are unenforceable liens and rights without present remedy. (MacMillan-Fla)
W69-00476

SMALLWOOD V CONNER (REASONABLE VALUE OF RIGHT TO WELL USE IMPLIED).

162 S E 2d 747-748 (Ct App Ga 1968).

Descriptors: Georgia, Judicial decisions, Legal aspects, Usufructuary right, Water rights, *Wells, Value.

Conner conveyed to Smallwood a lot by warranty deed, excepting therefrom a 25-foot square in a corner on which was located a well. Right to use the well and to lay pipe was given. Some years later, Conner sued Smallwood, claiming $195 as due on a water bill, and obtained a judgment. The court in the instant case affirmed. The court stated that ex-

cept as between very near relatives, when one accepts services from another or is given a right to use a facility, a promise is implied to pay the reasonable value thereof. While the warranty deed in dispute clearly conveyed the right to use water from the well, it contained no provision whatsoever that the grantor would supply use of the water free of charge. The court affirmed that $3 per month was a reasonable charge. (Patterson-Fla)
W69-00486

WE NEED MORE MUNICIPAL WASTE TREATMENT WORKS,
David H. Howells.
Civil Eng, Vol 33, No 9, pp 54-55, Sept 1963. 2 p.

Descriptors: Legislation, Water law, *Water pollution control, *Federal government, Pollution abatement, Water pollution treatment, Navigable waters, Municipal wastes, Industrial wastes, Legal aspects, State governments, Local governments, Federal project policy, *Cost sharing, Sewage treatment, Waste treatment.

There are 5,831 cities and towns in the United States, representing over 35 million people, that need new or enlarged plants for the treatment of municipal wastes. The cost of this backlog of needed treatment plants, interceptor and outfall sewers, and other ancillary works, has been estimated at 2.2 billion dollars. The Federal Water Pollution Control Act of 1956, provided the first real impetus to the control of pollution from municipal wastes by authorizing annual appropriations of 50 million dollars for grants of up to 30 percent of the cost of sewage treatment works. In 1961, the Congress amended the Act of 1956 to authorize an increased annual appropriation of 80 million dollars for 1962, 90 million for 1963, and 100 million for 1964 through 1967. It also encouraged communities to construct joint rather than separate projects and increased the 30 percent grant limitation from 250,000 dollars to 600,000 dollars. (R. Smith-Fla)
W69-00493

LEGAL ASPECTS STIMULATE POLLUTION CONTROL PROGRAM,
Murray Stein.
Civil Eng, Col 32, No 7, pp 50-51, July 1962. 2 p.

Descriptors: Legislation, Water law, *Water pollution control, *Federal government, Pollution abatement, Water pollution treatment, Navigable waters, Public health, Water pollution sources, Municipal wastes, Industrial wastes, *Legal aspects, State governments, Local governments, Missouri River.

Remedial waste collection and treatment facilities for municipalities and industries on the stretch of the Missouri River from Sioux City to St. Louis, costing an estimated $350,000,000, are currently in various stages of construction. Much of this activity may have resulted from the four federal enforcement actions taken to abate the pollution of this stretch of the river under the Federal Water Pollution Control Act of July 1956. This article examines in depth the various sections of the Act and concludes that it truly comprises a comprehensive statutory basis for the federal role and responsibility in the prevention and control of water pollution. Since the start of the program in 1956, a total of 2,746 communities began construction of treatment plants with federal funds made available under the act. The total cost of these projects was $1,293 million of which 17% were federal funds. (R. Smith-Fla)
W69-00494

UNDERGROUND-WATER RECLAMATION GRANTS.
43 USCA Secs 351-360 (1964).

Descriptors: *Federal reclamation law, *Permits, Exploration, Drilling, *Water resources development, Patents, *Subsurface waters, Subsurface investigations, Nevada, Federal government, Mineralogy, Coals, Public lands, Reclamation, Regulation, Federal reservations.
Identifiers: *Secretary of the Interior, Land disposal.

Section 351 empowers the Secretary of the Interior to grant exclusive two-year permits to United States citizens to drill for water beneath the surface of designated public lands of the United States in Nevada. Section 352 authorizes the Secretary to designate the lands subject to disposal under this chapter. Section 353 prescribes the procedure and fees for obtaining such a permit. Section 354 empowers the Secretary to cancel the permit under specified conditions. Section 355 entitles the permittee to a patent over one-fourth of the land embraced in the permit if he discovers and develops a specified quantity of water within two years. Section 356 authorizes the Secretary to grant a two-year extension of the time limit. Section 357 provides for the disposition of lands not included in the patents; under Section 358 the proceeds from such dispositions go into a specified reclamation fund. Section 359 reserves to the United States all the coal and other valuable minerals in the lands entered and patented, plus the right to mine and remove them. Section 360 empowers the Secretary to promulgate any regulations necessary to achieve the purposes of the chapter. (Smodish-Fla)
W69-00507

ESTIMATING CONSTRUCTION COSTS,
Day and Zimmermann Consulting Services, Inc.
Thomas W. Hopper.
Consult Eng, Vol 31, No 2, pp 94-98, Aug 1968. 5 p, 1 tab.

Descriptors: *Construction costs, *Estimating, Costs, Overhead costs, Contracting, Bids, Depreciation, Unit costs, Finance, Materials, Foreign construction, Feasibility studies, Consulting engineers, Investigations, Scheduling, Labor.
Identifiers: Agency for Intl Dvlpmt, Construction materials, Profits, Equipment.

The most important uses of construction cost estimates are determining project feasibility and the amount of required financing. In 1967, the Agency for International Development requested an investigation of methods used by consulting engineers and contractors in preparing construction cost estimates for large civil works projects. The investigation revealed that: (1) not enough time is spent on estimating construction costs; (2) engineers concentrate on direct costs and do not thoroughly consider indirect costs that must be included; and (3) the contractors' business costs, including risks, escalation, and legal requirements, are overlooked or not covered sufficiently. Information used in the estimating process should be developed from four sources: site conditions, work division and quantities, construction program, and unit costs. Costs are divided into direct costs (those associated with specific construction operations) and indirect costs (those related to the general construction operation) such as in administrative overhead. Two important estimate items are project mobilization which can be a large part of the project cost, and markup which should be 15 to 20% of the total cost for an average road project in an underdeveloped country. (USBR)
W69-00566

COSTS AND RETURNS FROM CROPS AND LIVESTOCK IN THE UPLAND DESERT VALLEYS OF NEVADA,
Nevada Univ., Reno.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00638

THE MEASUREMENT AND COMPARISON OF COSTS FOR ALTERNATIVE WATER REPLACEMENT PROJECTS,
Louisiana State Univ., Baton Rouge.
L. H. Falk, and W. J. Stober.
Louisiana Water Resour Res Inst Bulletin 2, Oct 1966. 33 p, 1 fig, 7 tab, 13 ref, append. OWRR Project B-001-La.

Descriptors: *Cost comparisons, Costs, *Water supply, Ground water, Wells, Municipal water, *Water costs, Economics, Taxes, Construction costs, Capital costs, Water rates, Water wells, Cost analysis.
Identifiers: Water plans.

Water replacement projects may be undertaken by water users individually or by collective community action. Cost is a primary determinant in the choice among alternative projects. The cost concept relevant for such comparisons is the present value unit cost of water, which may be viewed as an internal price just sufficient to cover all costs. This may be computed by discounting all costs and water outputs by the cost of capital to the sponsoring agency. Calculations indicate that the nonprofit community project can supply water to corporate users at a lower cost than that at which corporate users can supply their own needs. This is attributed to (a) the corporate income tax structure, and (b) the lower cost of capital to the community project. The results of detailed calculations for a hypothetical project are presented in tabular form. In addition, a graph is included that shows the extent to which construction costs for the community project must exceed those for the corporate project to equalize the costs of water from the 2 alternatives.
W69-00641

ECONOMIC CONTROL OF GROUNDWATER RESERVES,
Missouri Univ, Columbia, Dept. of Agricultural Economics.
Oscar R. Burt.
Journal of Farm Economics, Vol 48, No 3, Part 1, pp 632-647, Aug 1966. 16 p, 14 ref.

Descriptors: *Temporal distribution, Costs, *Optimization, *Markov processes, *Mathematical studies, *Functional equations, *Commonality.
Identifiers: Economics, *Groundwater basins.

A framework is developed for the derivation of optimal ground water policies based on sequential decision theory. The policies are based on temporal allocation. The commonality problem is the primary consideration. Two criterion are chosen. The first criterion is the expected present value of net output from the basin. The deviation and solution of the functional equation to maximize this criterion is discussed. The second criterion is the dispersion of net output. Throughout the discussions, the context of net social benefit as a prerequisite for an economic solution is maintained. Markov process analysis is combined with the other mathematical techniques in deriving the optimal solution to the commonality problem. (Grossman-Rutgers)
W69-00678

EFFECTS OF HIGHLY MINERALIZED WATER IN HOUSEHOLD PLUMBING AND APPLIANCES,
Black and Veatch, Construction Engineers, Kansas City, Missouri.
W. L. Patterson, and R. F. Banker.
J Amer Water Works Ass, Vol 60, No 9, pp 1060-1069, Sept 1968. 10 p, 7 fig, 2 tab.

Descriptors: *Corrosion, *Plumbing, *Damages, *Domestic water, *Cost analysis, Water quality, Hardness (Water), Salinity, Dissolved oxygen, Sulfates.
Identifiers: Household plumbing life.

The effects of total dissolved mineral content of domestic water on service lives and annual costs of items of household plumbing and appliances are estimated. The average household plumbing investment is about $1,100. Study of 38 communities shows reductions in service life of 30% in washing machines to 70% in toilet flushing mechanisms from the effect of water of 1,750 ppm. The annual

cost of such reduction is about $40. The indirect capital costs of reduced life amounts to about $0.40 per 1,000 gal, which exceeds the price of water in many communities. The waters studied had mineral contents not commonly affected by water treatment. The constituents listed are TDS, hardness, sulfate, chloride, and dissolved oxygen. The data obtained in the community surveys are tabulated. (Knapp-USGS)
W69-00704

6D. Water Demand

WATER BASED RECREATION IN NEVADA - TAHOE,
Nevada Univ., Reno, Water Resour. Res. Center.
George A. Myles.
Prog Rep 3, Nov 1966. 22 p, 1 photo, 7 tab. OWRR Proj A-004-Nev.

Descriptors: *Recreation facilities, *Recreation demand, *Nevada, *Expenditures, Beaches, Camping, Camp sites, Lakes, Reservoirs, Social aspects, Tourism, Use rates, Water demand.

National studies estimate that the U S population will double by the year 2,000, but that in this same period the demand for outdoor recreation will triple. With Nevada's rapidly expanding population, estimated to be 500,000 in 1966, and increasing tourist travel by automobile, it is likely that the demand for water based recreation within the state will exceed national averages. The purpose of this study is to provide information concerning: (1) the use of water based recreational areas, (2) desire for satisfaction with facilities and services, (3) the using public's willingness to pay for use of areas and facilities, (4) the expenditures of visitors, and (5) characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. A survey was conducted at major water areas providing information for all of Nevada's major water recreation areas. Results are given for each area because each has its own peculiarities and information is more meaningful on an area basis. A summary of and recommendations for all areas are provided. This work is concerned primarily with Lake Tahoe located in the Sierra Nevada Mountains at 6,000 ft.
W69-00463

WATER BASED RECREATION IN NEVADA - MEAD AND MOHAVE,
Nevada Univ., Reno, Water Resour. Res. Center.
George A. Myles.
Desert Res Inst Proj Rep 3A, Dec 1966. 24 p, 7 tab, 6 photo. OWRR Proj A-004-Nev.

Descriptors: *Recreation facilities, *Recreation demand, *Nevada, *Expenditures, Beaches, Camping, Camp sites, Lakes, Reservoirs, Social aspects, Tourism, Water demand.

National studies estimate that the U.S. population will double by the year 2000, but that in this same period the demand for outdoor recreation will triple. With Nevada's rapidly expanding population, estimated to be 500,000 in 1966, and increasing tourist travel by automobile, it is likely that the demand for water based recreation within the state will exceed national averages. The purpose of this study is to provide information concerning: (1) the use of water based recreational areas, (2) desire for or satisfaction with facilities and services, (3) the using public's willingness to pay for use of areas and facilities, (4) the expenditures of visitors, and (5) characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. A survey was conducted at major water areas providing information for all of Nevada's major water recreation areas. Results are given for each area because each has its own peculiarities and information is more meaningful on an area basis. A summary of and recommendations for all areas are provided. This work is concerned primarily with the Mead-Mohave recreation area in southern Nevada.
W69-00464

WATER BASED RECREATION IN NEVADA WESTERN DESERT AND NORTHERN LAKES,
Nevada Univ., Reno, Water Resour. Res. Center.
George A. Myles.
Desert Res Inst Proj Rep 3B, Mar 1967. 74 p, 4 fig, 10 photo, 2 dwg, 21 tab, 3 chart, 3 append. OWRR Proj A-004-Nev.

Descriptors: *Recreation facilities, *Recreation demand, *Nevada, *Expenditures, Beaches, Camping, Campsites, Lakes, Reservoirs, Social aspects, Tourism, Water demand.

National studies estimate that the U.S. population will double by the year 2,000, but that in this same period the demand for outdoor recreation will triple. With Nevada's rapidly expanding population, estimated to be 500,000 in 1966, and increasing tourist travel by automobile, it is likely that the demand for water based recreation within the state will exceed national averages. The purpose of this study is to provide information concerning: (1) the use of water based recreational areas, (2) desire for or satisfaction with facilities and services, (3) the using public's willingness to pay for use of areas and facilities, (4) the expenditures of visitors, and (5) characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. A survey was conducted at major water areas. This study provides information for all of Nevada's major water recreation areas. A summary and recommendations for all areas are provided. Results are given for each area because each has its own peculiarities and information is more meaningful on an area basis. This study includes Pyramid, Topaz, Walker and Lahontan Reservoir in the west; Rye Patch and Wildhorse Reservoirs, Ruby and Angel Lakes in the north.
W69-00465

SOME OBSERVATIONS ON THE LAW OF WATER ALLOCATION AS A VARIABLE IN INDUSTRIAL SITE LOCATION,
Wisconsin Univ., Madison.
Sheldon J. Plager.
Wis L Rev, Vol 1968, No 3, pp 673-692, 1968. 20 p, 112 ref.

Descriptors: Michigan, Georgia, Water law, Riparian rights, Natural flow doctrine, Reasonable use, *Industrial plants, *Water allocation (Policy), Public benefits, Water utilization.

The article compares water allocation patterns obtaining in a natural flow jurisdiction (Georgia) with those of a reasonable use jurisdiction (Michigan). The patterns are evaluated from the viewpoint of the industrial water user and from that of the public interest in optimum water usage. In a natural flow jurisdiction maximum protection of water supply investment is obtained by locating the plant on riparian land at the furtherest downstream point that a riparian use is possible, thus minimizing the limitation to use created by downstream riparians' rights to natural flow. In reasonable use jurisdictions the opposite is the case, since reasonable use by those upstream (regardless of the time of their arrival) could cut into the lower owner's rights. Courts are less likely to include public interest as a significant factor in the decisional process in a natural flow jurisdiction. Illustrative of the manner in which water laws have often operated in substantial disregard of water facts, defeating the public interest in optimum water use, is the Michigan preference for the upper user in a climate where evaporation losses are small. The converse is the case in Georgia. (MacMillan-Fla)
W69-00467

RAW ENERGY SOURCES FOR ELECTRIC GENERATION,
Ebasco Services Inc, New York, N Y.
F. A. Ritchings.
Inst Elec Electron Eng Spectrum, Vol 5, No 8, pp 34-45, Aug 1968. 12 p, 9 fig, 9 tab.

Descriptors: *Electric power production, Nuclear powerplants, Electric power, Nuclear energy, *Energy, *Hydroelectric power, Costs, Atmospheric pollution, *Consumption, *Forecasting, Resources, Resource development, Water resources, Economics, Transportation.
Identifiers: Electric utilities, Gross national product, Investment, *Fossil fuels, *Nuclear fuels.

The energy picture in the United States through 1985 is outlined. Predictions are that by 1985 nuclear sources will provide more than 40% of the total raw energy for electric power generation in the U S, ranging from 25% in the southwest to more than 70% in New England. Forecasts are based on several factors, including economics, present and future estimates of fuel availability, plant size, transportation, and air pollution. On a national basis, predictions are that consumption of all forms of raw energy for electric generation will increase substantially from now to 1985, with nuclear energy making the greatest gains. (USBR)
W69-00567

ELECTRIC POWER DEVELOPMENT IN THE USSR.

Water Resour J, pp 67-79, Dec 1967. 13 p.

Descriptors: *Electric power production, *Planning, Economics, Thermal power, River basin development, Hydroelectric power, *Foreign countries, Research and development, Natural resources, Costs, Benefit-cost ratios, Transmission (Electrical), Administration, Operation and maintenance, Analysis, Management, Population.
Identifiers: *Rural electrification, Economic evaluation, *Developing countries, Economic growth, Nuclear power, USSR.

Experiences in electric power development in the USSR are related to comparable conditions in developing countries in Asia and the Far East which are anxious to accelerate the electrification program. Research work completed in developed countries can be beneficial to the developing countries of the Economic Commission for Asia and the Far East regions. Broad classifications of technoeconomic aspects requiring consideration in the field of electric power production are: (1) planning studies for developing natural energy sources, (2) implementing and administering projects under a comprehensive development plan, and (3) solving technical problems of layout, design, construction, and operation and maintenance of the projects. Observations and conclusions of participants in a seminar and study tour hosted by the USSR are discussed. The seminar and study tour began in Leningrad, proceeded to Volgograd, Yerevan, and Kiev, and ended in Moscow. (USBR)
W69-00569

FEASIBILITY OF WATER EXPORT,
Manitoba Univ, Winnipeg, Canada.
Edward Kuiper.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY4, pp 873-891, July 1968. 19 p, 5 fig, 1 tab, 6 ref, 2 append.

Descriptors: *Water, USA, *Water costs, Water supplies, International compacts, Diversion, Water resources, Project planning, Planning, Water requirements, Policy matters, Economics.
Identifiers: *Water transfer, *Water plans, *Canada, Water shortages, Surplus water, *Export, Treaties, *Import, Inter-basin transfers.

A review is given of various aspects associated with exporting water from one country to another. The first part of the paper deals with the general criteria that must be satisfied before export can be contemplated; the second part describes the application of these criteria to the Canada-United States situation. The continent is divided into 3 regions: mountain west, prairie, and east. Canada's surplus water in the foreseeable future and the approximate cost of providing it to the U S are calculated for each region. The surplus surface water is 100,000,000 ac-ft/yr in the mountain west, 100,000,000 ac-ft/yr in

the prairie region, and 200,000,000 ac-ft/yr in the eastern region. (USBR)
W69-00601

NORTHWEST-SOUTHWEST WATER DIVERSION - PLANS AND ISSUES,
Oregon Univ., Eugene.
Chapin D. Clark.
Willamette Law J, Vol 3, No 4, pp 215-262, 1965. 48 p, 143 ref. OWRR Project A-002-Ore.

Descriptors: Water resources, *Diversion, Water law, Arizona, Interstate compacts, States (Geographical), Underwater, Aqueducts, *Reviews, Bibliographies, Policy matters, *Water transfer, California, Pacific Northwest U.S., Legal aspects.
Identifiers: *Water plans, Water shortages, Pacific Southwest, Pacific SW Water Plan.

Inter-regional diversion of water in the western half of the United States is the most important and controversial issue concerning the management of natural resources presently faced by Congress. Its expense and its precedent require that the existing assumptions about the nature of the water problem and the techniques for its solution be reexamined. The present Congress (89th, 2d Session) may authorize a feasibility study leading to the augmentation of the Colorado River by the transfer of water from the Pacific Northwest. In view of the imminence of the decision, the objective of this article is to present an overview and bibliography of the Northwest-Southwest water diversion issue. The article summarized (1) the political evolution of NW-SW diversion proposals, (2) the physical and institutional factors which press for the acceptance of diversion, and (3) the various diversion schemes suggested by engineers. It concludes with a sketch of the policy issues which are posed by an inter-regional diversion.
W69-00617

SURVEY OF THE NATURE AND MAGNITUDE OF THE WATER RESEARCH NEEDS OF THE TEXTILE INDUSTRY OF GEORGIA,
Georgia Institute of Technology, Atlanta.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00639

WATER: AS A FACTOR TO ATTRACT INDUSTRIES,
Ministry of Agriculture, Ankara, Turkey.
Ismail Sener.
Univ Nebraska, Agr Exp Sta, Rep No 45, March 1967. 18 p, 1 tab, 17 ref. OWRR Project A-004-Nebr.

Descriptors: Water demand, *Water costs, *Locating, *Water supply, Water utilization, Economics, Water quality, Industrial water, Reviews, *Industries, Water shortage.
Identifiers: Allocations, Water facilities, *Industrial development.

Water as a required resource for industry has received nationwide attention in recent years. This study is based largely on a review of literature and interviews with researchers. Water requirements by industry vary--among 38 industries the range is from 80 gallons per gallon of whiskey to 1,920,000 gallons per ton of aluminum. Technology exists that can greatly reduce water requirements--water use per ton of output varies from 1400 gallons to 65,000 gallons for steel and from 1500 to 70,000 gallons for sugar. Site selection by industry is based on many factors considered more important than water because water costs are generally low. A 100% increase in the cost of water to 5 heavy water using industries would increase cost of products less than 1%. The cost of water is generally so low that economic principles are not applied in its use or allocation. The importance of water as a factor in locating industry often has been exaggerated.
W69-00650

PROJECTED RESIDENTIAL WATER REQUIREMENTS FOR THE PLATTE AND GREEN RIVER BASINS IN WYOMING; 1965-2010,
Wyoming Univ., Laramie, Coll. of Commerce and Industry.
James C. Kildebeck, Orman H. Paananen, and John W. Birch.
Wyo Water Resour Res Inst Ser No 5, Univ Wyo, July 1967. 50 p, 2 fig, 40 tab, 2 appen. OWRR Project A-001-Wyo.

Descriptors: *Water requirements, Forecasting, Statistical methods, Water utilization, Estimating equations, Time, Temperature, Costs, *Wyoming, Variable costs, Water consumption, Water demand, *Domestic water, *Municiapl water.

This report provides estimates of long-term residential water requirements for the Platte and Green River Basins of Wyoming. Estimates of residential water use are shown by 5-yr intervals for counties and the entire basin area. Estimates are preliminary and additional research now underway may provide additional evidence to modify initial estimates. Projections are derived from mathematical estimating equations in which temperature, water cost, and time are used as variables for estimation of per capita water consumption. Water consumption data were obtained from a survey of 6 communities in the Platte River Basin (comprising about 2/3 of the basin population), and from Rock Springs and Green River in the Green River Basin. For Platte River Basin, total residential water consumption is expected to increase from 8.3 million gallons/yr in 1965 to 38.3 million gal/yr by 2010. While population in the Platte River Basin is expected to nearly double during this time period, residential water consumption is expected to increase 4 to 5 times. Green River Basin, residential water consumption is expected to increase from 2 million gallons per year in 1965 to 5.4 million gallons per year in 2010.
W69-00668

ECONOMIC IMPACT ON SOUTHWESTERN WYOMING OF RECREATIONISTS VISITING FLAMING GORGE RESERVOIR,
Wyoming Univ., Laramie.
Rodney C. Kite, and Willard D. Schutz.
Wyoming Agr Exp Sta Res J 11, Aug 1967. 24 p, 11 tab, 11 ref, 2 append. OWRR Project A-001-Wyo.

Descriptors: *Recreation, Boating, Demand, Water demand, Wyoming, Input-output analysis, Expenditures, *Economic impact.
Identifiers: *Flaming Gorge Resvr, Utah, Upper Green River, Interviews, Transactions.

The purpose of this study was to analyze the economic impact of expenditures by recreationists visiting Flaming Gorge Reservoir in Southwestern Wyoming in 1962. Through the use of personal interviews, average expenditure for 173 parties was determined. The expenditure was $10.68 per party, with the largest part, $5.26, being spent for gasoline and oil. The Leontief static, open input-output model was used in analyzing economic impact. An overall multiplier of 2.067 was found. This expanded direct benefits from $529,728 to a total benefit of $1,094,798. Sectors receiving the greatest total benefit were, in order of importance: (1) gasoline service stations, (2) other retail, (3) general wholesale, (4) households, and (5) food and beverage establishments. This study is important in showing impact of recreational spending. An appendix presents details on the input-output model including the transactions matrix, the input coefficients, and the multiplier matrix for the study area.
W69-00672

6E. Water Law and Institutions

LECTURES ON LAW IN RELATION TO WATER RESOURCES USE AND DEVELOPMENT,
Univ. of Connecticut, Storrs.
William C. Kennard.
Inst Water Resour, Univ Connecticut Rep 2, Mar 1967. 27 p, 12 ref. OWRR Project A-999-Conn.

Descriptors: *Water law, Riparian rights, Prior appropriation, Water management (Applied), Water pollution control, *Water rights.

Four lectures on water law given in the seminar program of the Institute of Water Resources at the University of Connecticut during the fall semester of the 1966-67 academic year are given in this publication. Dr. F. J. Trelease of the University of Wyoming discussed and contrasted the doctrines of prior appropriation in the western states and riparian rights in use in the eastern states. He stressed the need for a good, comprehensive water use code. Mr. J. J. Curry discussed the role and problems of the Connecticut Water Resources Commission in administering water legislation. Such a group plays two roles; to prevent or discover and eliminate unreasonable use and to develop methods by which riparians can make increasing use of their water rights without detriment to others. Mr. I. L. Newell of the Henry Souther Engineering Co. of Hartford stated that in Connecticut the control of water and wastes is given to two separate agencies, the State Department of Health and the Water Resources Commission. He commented on the recommendations of the Clean Water Task Force. In the final lecture, Mr. W. M. Champion of the University of Mississippi commented on development of policy with regard to water law and the administration of a water rights system.
W69-00400

BIBLIOGRAPHY ON MONTANA'S WATER AND RELATED LANDS RESOURCES,
Montana Univ., Missoula, Water Resour. Res. Center.
Richard G. Sheridan.
Rep 1, Mont. Univ, Dec 1966. 81 p, 947 ref. OWRR Proj B-004-Mont.

Descriptors: *Bibliographies, *Montana, *Water resources, *Land resources, Dams, Agriculture, Irrigation, Reservoirs.

This bibliography has been prepared to make available to researchers, educators, and the general public source materials about Montana's water and related lands resources. In Montana, as in other states, it is difficult to find collected in one place all published materials relating to this subject. In this bibliography an attempt was made to be as complete as possible. Books and articles have been arranged by the limited subject within the water resources field. In addition, a number of sources of general concern to the student in this area are collected near the end of the bibliography. The material relating to governmental administration of water resources is particularly complete. Finally, the bibliography concludes with a list of organizations in the state who have particularly concerned themselves with water resources activities in Montana.
W69-00451

A COMPREHENSIVE WATER AND RELATED LAND RESOURCES PLAN FOR THE STATE OF NEVADA,
Nevada Dept. Conserv. and Natur. Resour., Carson City.
Hugh A. Shamberger.
Inventory Series 1, July 1967. 38 p. OWRR Proj A-999-Nev.

Descriptors: Planning, State governments, Federal government, *Nevada, Census, Resource develop-

ment, Land use, *Land resources, *Water resources, Natural resources, *Water resources development.

This is the first report in the inventory series prepared for the Nevada Department of Conservation and Natural Resources. The data contained in the Inventory Series will lay the foundation for the preparation of a Water and Land Resources Plan for Nevada. It has long been realized that a directory of federal and state agencies working in the field of natural resources in Nevada would be helpful and to be effective must be kept up-to-date. It is planned to revise this directory at least every 2 yrs.
W69-00462

UNITED STATES V BIGAN (VIOLATION OF RIVERS AND HARBORS ACT-REMEDY).
274 F 2d 729-733 (3d Cir 1960).

Descriptors: Legislation, *Judicial decisions, *Rivers and Harbors Act, *Navigation, *Federal government, Rivers, Navigable rivers.

Defendant operated a strip mining operation at the top of a hill above the Allegheny River. It piled excess earth on an abandoned mining road near the bank of the river. A torrential rain washed this earth, along with brush and trees, into the river creating a bar extending about fifty feet out from the shoreline. The United States brought suit against defendant alleging a violation of the Rivers and Harbors Act, and seeking to invoke the mandatory injunction provision of the Act. The District Court found that such provision could be invoked only to force removal of structures such as docks, constructed in violation of the Act (Sec 10) and that conditions were not such that the court should use its general equity power. This court affirmed, stating that the defendants conduct was negligent and in violation of the Act, but was not the type of violation for which the Act authorizes a mandatory injunction. The court also accepted the findings of the District Court that the situation did not call for the exercise of the general equity power. (R. F. Williams-Fla)
W69-00468

UNITED STATES V GRAND RIVER DAM AUTHORITY (FEDERAL FLOOD CONTROL UNDER COMMERCE CLAUSE).
363 US 299; 80 S Ct 1134-1139 (1960).

Descriptors: *Judicial decisions, Legislation, Navigable water, Navigable rivers, *Federal-state water rights conflicts, Compensation, Condemnation, Federal government, Federal Power Act, *Hydroelectric plants, *Tributaries, Dams, Non-navigable waters.

Respondent was created by the Oklahoma legislature to develop hydroelectric power on the non-navigable Grand River, a tributary of the navigable Arkansas River. It obtained a license under the Federal Power Act and constructed a project on the Grand River. Later, the federal government incorporated the Grand River into its comprehensive plan for the regulation of navigation, flood control, and power production on the Arkansas and its tributaries. It constructed a project on the Grand River, and in connection therewith, condemned a tract of respondent's land, acquired flowage rights over these lands, and paid for relocation of transmission lines. Respondent claimed additional compensation for the taking of its water right and franchise to develop hydroelectric power. The Court of Claims found the U S liable and on certiorari, the US Supreme Court reversed. The power of flood control extends to tributaries of navigable streams. Deprivation of the opportunity to use water for power production in these circumstances is not compensable because of Congress' superior rights under the Commerce Clause. Since no property was taken from respondent, compensation was not required under the Fifth Amendment. (R. F. Williams-Fla)
W69-00470

LOBEAN V TRUSTEES OF THE INTERNAL IMPROVEMENT FUND (TITLE TO SUBMERGED LANDS).
118 So 2d 226-230 (1st DCA Fla 1960).

Descriptors: *Beds, *Ownership of beds, *Taxes, Boundaries (Property), Real property, Florida, Beds under water, Judicial decisions.
Identifiers: Estoppel.

The Trustees of the Internal Improvement Fund issued a Murphy Act deed to the plaintiff in 1946. The deed purported to convey certain submerged lands. In 1956, the trustees advertized a large area of land, including the plaintiff's lot, for sale and the plaintiff brought suit to enjoin such sale. The court held that the Murphy Act deed which the Trustees sold was void and conveyed no title or interest because the lands were submerged and were therefore sovereignty lands not subject to taxation. However, the court held that the Trustees were legally estopped to question the validity of the Murphy Act deed they had issued in 1946. The court did not reach the question but indicated that the Trustees might also be equitably estopped to question the deed. (Horner-Fla)
W69-00471

BOUDREAUX V LANDRY (INTERFERENCE WITH EASEMENT FOR ACCESS TO STREET).

120 So 2d 535-538 (1st Cir Ct App La 1960).

Descriptors: *Judicial decisions, Louisiana, *Easements, *Drains, Ditches, Prescriptive rights, Roads, Access routes.

Plaintiff owned land on the south side of a street. Between his land and the street was a five-foot strip of land. The owner of this strip conveyed an easement to plaintiff for access to the street. Several years later the defendant, police juror for the area, desired to deepen and extend a ditch which was partly on the strip of land. The defendant secured the assent of the owner and commended work over the objections of plaintiff. Plaintiff brought suit for an injunction and damages, claiming that construction of the ditch without his consent constituted a taking of his property without compensation. The trial judge found that plaintiff's restricted right of access to the street was not taken. This was affirmed on appeal. The court held that plaintiff's servitude was only for access directly across the strip. The ditch had not been extended to plaintiff's driveway, so his access had not been interfered with. The court stated that damages would lie if plaintiff's access to the street was interfered with. (R. F. Williams-Fla)
W69-00472

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT V GRIFFITH (NAVIGATION RIGHTS OF RIPARIAN OWNER).
119 So 2d 423-426 (3rd DCA Fla 1960).

Descriptors: *Judicial decisions, Florida, Riparian rights, Canals, *Navigation, Navigable waters, *Public rights, Dams.
Identifiers: Private rights.

Plaintiff, a riparian owner on a canal, brought suit to enjoin the Central and Southern Florida Flood Control District from constructing a salt water control dam on the canal between plaintiff's land and Biscayne Bay. Plaintiff contended that such a dam would deprive it of its right to have unobstructed navigation and access to Biscayne Bay. Plaintiff had no interest in the land which was condemned for construction of the dam, or in the bed of the canal. The chancellor found that the canal was a private navigable waterway owned by appellees and others with similar rights and granted a permanent injunction. On appeal, the Third District Court of Appeals reversed the decision. A riparian owner does not have a vested right to unobstructed navigation, but merely enjoys this right in common with the public. The eminent domain statutes protect only private rights, and plaintiff has only a public right. (R. F. Williams-Fla)
W69-00475

ROY, INC V BOARD OF COMM'RS FOR PONTCHARTRAIN LEVEE DISTRICT (MEASURE OF DAMAGES FOR TAKING OF LAND ABOVE MEAN HIGH WATER MARK).

117 So 2d 60-63 (La 1960).

Descriptors: *Judicial decisions, Louisiana, Lakes, *Lake shores, Tides, *Eminent domain, Condemnation, Levees.
Identifiers: Damages (Legal aspects).

Plaintiff landowner brought an action for damages for the taking of his property by a levee district. The trial court found that the land was above the mean high water mark of the lake upon which it bordered, and awarded damages based upon the fair market value of the land at the time of the taking, plus interest from the date of judicial demand for damages (8 years after the taking). Plaintiff appealed, contending in the alternative that the damages should be the fair market value of the land at the time of the suit, or that interest should have been paid from the time of the taking of the property. The court found that the evidence sustained a finding that the land was above the mean high water mark and therefore subject to private ownership. Where a landowner has knowledge of a taking and stands by without complaint, the damages should be the fair market value of the land at the time of the taking. Pursuant to a statute stating that interest becomes payable from the time a debt comes due, the court held that interest should be paid from the date of the taking. (R. F. Williams-Fla)
W69-00477

JONES V HOGUE (OWNERSHIP OF ALLUVION).

116 So 2d 334-342 (2d Cir Ct App La 1959).

Descriptors: *Judicial decisions, Louisiana, *Accretion (Legal aspects), *Boundaries (Property), Legislation, Riparian rights, Rivers, Banks, Riparian land.

Plaintiffs sought a declaratory judgement apportioning alluvion formed in front of their land and the land of the defendants, adjoining riparian owners. The alluvion was formed over many years and was reflected in five Corps of Engineers' hydrographic surveys. The trial judge interpreted the pertinent statute to require that the alluvion be apportioned at the time of its formation, based on the entire area of the alluvion and entered judgment accordingly. On appeal by plaintiffs, the Second Circuit Court of Appeal of Louisiana reversed the trial court. The court stated that the lower court should merely accept the extent and area of the deposit at the time apportionment is sought. Next, the court held that pursuant to the statute, each riparian owner was to own the same proportion of the new front line or river bank as he had on the old river bank. The point on the new river bank reflecting each owner's proportionate share should simply be connected with the point on the old river bank which marked his property line. (R. F. Williams-Fla)
W69-00478

MENTOR HARBOR YACHTING CLUB V MENTOR LAGOONS, INC (NAVIGABILITY).
170 Ohio St 193; 163 N E 2d 373-378 (1959).

Descriptors: *Judicial decisions, Ohio, *Navigable waters, Recreation, Sand bars, Artificial watercourses, Freshwater marshes, Boating, Natural streams.

An adjacent land owner to an improved channel sought to enjoin owners of land adjacent to lagoons which were connected to Lake Erie by the channel from using the channel. The Supreme Court of Ohio, reversing, found for the defendants that the

watercourse in its present state, including both the channel and the lagoons, were navigable and public waters. The court considered the capacity for boating in natural condition, the capacity for boating after the making of reasonable improvements, and accessibility by public termini. Under Ohio case law navigation for pleasure and recreation is as important to the law as navigation for commercial purposes and a natural temporary obstruction to navigation, in the form of a sand bar, does not destroy the otherwise navigable characters of a watercourse. (MacMillan-Fla)
W69-00481

TOWN OF HEMPSTEAD V LITTLE (RIPARIAN RIGHTS BY ACCRETION).
239 N E 2d 722-725 N Y 1968).

Descriptors: New York, Judicial decisions, *Riparian rights, Boundaries (Property), Boundary disputes, Eminent domain, *Ownership of beds, Riparian land, Water law, *Accretion (Legal aspects).

The issue is whether the Town of Hempstead was a riparian owner entitled to the benefit of the land under water as it accreted and became a part of existing upland owned by the town, or whether Little, the party having title to the land formerly under water, retained title notwithstanding such accretion. The court declared the law on the question to be as follows: Gradual encroachment results in a loss to the riparian owner; but when the land is increased by accretion, i.e., by such a slow and gradual deposit of particles that its progress cannot always be measured even though its results may be discerned from time to time--the new land thus formed belongs to the owner of the upland to which it attaches. Applying this rule to the facts of the instant use, the court concluded that when Little's riparian property was condemned several years before this action was brought, Little retaining only fee to the submerged lands, the town acquired littoral rights including the right to the accretion formed. When the accretions covered Little's submerged lands, they became the property of the town. (Patterson-Fla)
W69-00484

DUMONT V SPEERS (REFUSAL TO AUTHORIZE FISHWAY UPHELD).
245 A 2d 151-155 (Me 1968).

Descriptors: Maine, *Administrative decisions, Legislation, Judicial decisions, *Fish passages, Administrative agencies.
Identifiers: *Public nuisance.

Chapter 331 of the Maine Public Laws of 1929 gives power over the supervision, administration and enforcement of inland game and fish laws to a single commissioner, who has power to require a fishway in a dam when he determines it expedient. Pursuant to Chapter 386 of the Public Laws of 1965, which gives the right to initiate a hearing to determine the expediency of a fishway in a dam to, among others, '200 citizens,' petitioners sought to require the Commissioner of Inland Fisheries and Game to require a fishway in a dam. The court sustained a dismissal of the petition on the ground, that, inter alia, the Commissioner's power to require a fishway is permissive, not mandatory. The legislation does not give petitioners de jure a claim for a fishway in the dam. Since there was legislative authority for the dam as it existed, the rule that obstructions to navigation and the passage of fish in navigable rivers or to the passage of boats, logs, and rafts in 'floatable' streams are public nuisances per se does not apply. (Patterson-Fla)
W69-00485

MEHENE V BALL (COMMON RIGHTS TO BEACH USE).

194 NYS 2d 28-32 (1959).

Descriptors: *Judicial decisions, New York, *Easements, Beaches, Lake Ontario, Recreation.
Identifiers: Tax deed.

This case involved a subdivision which bordered on Lake Ontario. A map which had been filed showing an undivided strip of land along the beach. Plaintiff purchased lots in the subdivision and constructed a permanent dock extending into the lake from the undivided strip (not owned by plaintiff). Defendant purchased a lot adjacent to the undivided strip, and purchased the land between her lot and the water from the county. The county had acquired title to the entire strip in a tax sale. Defendant graded the end of one of the subdivision's streets to improve her access to her lot and remove the part of plaintiff's dock on the land she acquired from the county. Plaintiff brought suit to establish his rights in the strip and street and to compel defendant to return the street and dock to their original condition. The court found that the beach was intended for the enjoyment of all the owners in the subdivision and that such was an easement not cut off by a tax deed. Damages sustained by plaintiff were readily ascertainable so the court refused to issue an injunction. (R. F. Williams-Fla)
W69-00488

LONG ISLAND LIGHTING CO V PEOPLE (OWNERSHIP OF ALLUVION).

196 NYS 2d 756-758 (1960).

Descriptors: *Judicial decisions, New York, State jurisdiction, *Accretion (Legal aspects), Breakwaters, *Riparian land, Beds.

Plaintiff was an owner of waterfront property on Long Island Sound. Its predecessor in title had acquired certain underwater lands by letters patent granted by the State of New York in 1929. As a condition of this grant, the grantee was required to construct certain breakwaters and dredge a channel. This was completed by 1934. Since the construction of the breakwaters, a change has come over the littoral land on either side of them. To the east, 12.25 acres of previously submerged land was exposed, and this controversy centered around this alluvion. Plaintiff submitted exhibits and an affidavit which showed that the increase of land was gradual over the past 25 years. Defendant submitted nothing to contradict plaintiff's evidence, and the court granted plaintiff's motion for summary judgment. Where accretion takes place, such gradual additions to the land belong to the littoral owner and not to the state. (R. F. Williams-Fla)
W69-00489

ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES,
Resources for the Future.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00496

COAST GUARD REGULATIONS, POWERS, AND NAVIGABLE WATERS.

Navigation and Navigable Waters, 33 USCA secs 2.01-1 - 2.99-270 (1968).

Descriptors: *Navigable waters, *Coast Guard regulations, *Administrative decisions, Administrative agencies, Legal aspects, Watercourses (Legal), *Jurisdiction.
Identifiers: *Coast Guard, Coast Guard jurisdiction.

Chapter 1. Navigable waters generally, is a part of Title 3 USCA, dealing with navigation and navigable waters. Subpart 2, with which this abstract is concerned, deals with regulations concerning general duties and jurisdiction. The scope of Subpart 2 includes rules and regulations which are statements of policy, interpretive rulings, or descriptions of practices with respect to the general duties and jurisdiction of the U S Coast Guard in the administration and enforcement of navigation and vessel inspection laws. The primary duties of the Coast Guard assigned by law and its law enforcement powers are set forth. The terms 'high seas,' 'navigable waters,' 'waters subject to the jurisdiction of the U S,' and 'state waters' are defined as they are used in statutes. The availability of Coast Guard and other administrative determinations as to navigability and other matters is described. Finally, internal waters of the U S that have been the subject of Coast Guard determinations of navigability are listed. (Patterson-Fla)
W69-00497

NAVIGABLE WATERS GENERALLY.

33 USCA Secs 1-59a.

Descriptors: *Regulation, *Legislation, *Navigable waters, *Non-navigable waters, Canals, Navigation, Interstate compacts.
Identifiers: *Secretary of the Army, Water gauges, Boundary water.

Section 1 establishes the duty of the Secretary of the Army to prescribe regulations for the use, administration and navigation of the navigable waters of the United States. Penalties for the violation of such regulations are set forth. The Secretary is empowered in sections 2 and 3 to regulate parts of the Mississippi River and waters used for military target practice. Section 4 authorizes the Secretary to establish water gauges on the Mississippi River and its tributaries, section 5 abolished tolls on governmental canals, canalized rivers, etc, and sections 6-10 deal with tolls and public use on various waterbodies. Section 11 authorizes the Middle Northwest States to compact as to jurisdiction of offenses committed on boundary waters. Sections 21-59a set forth various bodies of water declared by Congress to be non-navigable. (Patterson-Fla)
W69-00498

NIAGARA POWER PROJECT.

16 USCA Secs 836-836 (a) (1964).

Descriptors: *Federal Power Act, Electric power, Transmission lines, *Hydroelectric project licensing, New York, *Electric power rates, Project purposes, State governments, Power marketing, Scenic highways, Transmission (Electrical).
Identifiers: Niagara Power Project, Niagara River, New York State Power Authority.

The New York State Power Authority was authorized to receive a license from the Federal Power Commission for the construction and operation of a power project on the Niagara River. The license included conditions required by the Federal Power Act, as well as seven specific conditions for this particular project. These specific conditions require the licensee to give preference to public bodies and non-profit corporations within economic transmission distance in disposing of 50% of the project's power. Neighboring states would also be included in this preference. A percentage of the ramaining project power was required to be sold to the licensee of Federal Power Commission Project 16. Notes of decisions are included and updated by annual supplements. (Geraghty-Fla)
W69-00501

WATER CONSERVATION.

16 USCA Secs 590r-590z-11 (1964).

Descriptors: *Water conservation, *Water policy, *Water supply, *Water storage, Water users, Repayment contracts, Irrigation, Dams, Administrative agencies, Irrigation programs, Farms, Cost allocation, Programs, Projects, Federal government, Water utilization.

Chapter 3c of 16 USCA is divided into two subheadings. The first deals with facilities for water storage and utilization and the second with conservation and utilization projects. The first subheading authorizes the Secretary of Agriculture to formulate and keep current a program of projects for the construction and maintenance of ponds, reservoirs, wells, check dams, pumping installations, and other facilities for water storage or utilization. The Secretary is also authorized to make loans for the purpose of financing the improvement of farm land and to set up an efficient program whereby the government insures loans made for that purpose by other lenders. The second subheading authorizes the Secretary to investigate and construct water conservation and utilization projects in the Great Plains and arid and semiarid areas of the United States and to operate and maintain each project. The statute sets prerequisites which must be met before construction commences, provides for the utilization of services, materials and funds from sources outside the department. The repayment of projects by the water users is provided for in the act. (Horner-Fla)
W69-00502

FACILITIES FOR WATER STORAGE AND UTILIZATION.
16 USCA Secs 590r-590x-4.

Descriptors: *Water conservation, *Water policy, *Water supply, Water utilization, Irrigation, Administrative agencies, Federal government, Farms, Programs, Projects.

Sections 590r through 590x-4 of Title 16 USCA deal with facilities for water storage and utilization. The legislature cites the need for adequate facilities in upholding the national welfare. The Secretary of Agriculture may formulate a program of projects for construction and maintenance of facilities, construct and sell or lease the facilities, co-operate with and aid any agency or person and to acquire lands when necessary. Before extending benefits, the Secretary may require the enactment of State and local laws providing for conservation, the execution of agreements in regard to the maintenance and use of facilities, and contributions to operations conferring benefits. The Secretary may makes loans of federal money for the improvement of farm land or to insure loans made from other sources. The statute outlines a program for the execution, insurance and sale of loans. (Horner-Fla)
W69-00503

WATER CONSERVATION AND UTILIZATION PROJECTS.
16 USCA Secs 590y-590z-11.

Descriptors: *Water conservation, *Water policy, *Water supply, *Water storage, Water users, Repayment contracts, Water utilization, Dams, Irrigation programs, Farms, Federal government, Programs, Projects.

Sections 590y through 590z-11 of Title 16 USCA deal with conservation and utilization projects. For the purpose of stabilizing water supply and thereby rehabilitating farmers on the land and providing opportunities for settlement of farm families, the Secretary of the Interior may investigate and construct water conservation and utilization projects in the Great Plains and arid or semiarid areas of the country and operate and maintain each project. The statute outlines factors to be investigated and provides for the utilization of services, materials and funds of Federal, State, or municipal agencies or individuals in connection with the investigation, construction, or operation and maintenance of a project. No water may be delivered until repayment contracts have been executed by water users organizations or individual landowners. The statute sets certain provisions that must be contained in the contracts. The Secretary of Agriculture is authorized to arrange the settlement of the projects, to advise settlers, to acquire agricultural lands, and to arrange for the improvement of lands within project boundaries. Provisions may be made in connection with any project undertaken, for furnishing municipal water supplies or for developing and furnishing power. (Horner-Fla)
W69-00504

ACQUISITION OF LANDS OR INTERESTS THEREIN FOR USE IN GAGING STREAMS OR UNDERGROUND WATER RESOURCES.
43 USCA Sec 36b.

Descriptors: *Legislation, *Streams, Subsurface waters, Federal government, Gaging stations, Observation wells, Geological surveys, Underground streams, Water resources, Condemnation, State governments, Federal-state water rights conflicts, Irrigation water, Interstate rivers, Water rights, Right-of-way, Easements, Permits, Leases.
Identifiers: *Secretary of the Interior, Territorial Governments, Congressional appropriations, *Acquisition of lands.

Section 36b authorizes the Secretary of the Interior to acquire lands on behalf of the United States for use by the Geological Survey in gaging streams and underground water resources, not in excess of ten acres for any one stream gaging station or observation well site. For the same purpose the Secretary may obtain easements, licenses, rights-of-way, and leases limited to run for such time as may be required for effectively gaging streams and underground water resources. Nothing in the section is to be construed to affect or in any way interfere with the laws of any State or Territory relating to control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder. The Secretary, in carrying out the provisions of this section, is to proceed in conformity with such laws. Nothing in this section in any way affects any right of any State or of the Federal Government or of any landowner in, to, or from any interstate stream or its waters. (Smodish-Fla)
W69-00508

BEACH AND SHORE PRESERVATION ACT.

Fla Stat Secs 161.011-161.45 (1967).

Descriptors: *Florida, *Legislation, State governments, Local governments, Beach erosion, Sands, Shores, Coasts, *Shore protection, Coastal structures, Jetties, Breakwaters, Beaches, Federal government, Cost sharing, Permits.

The Beach and Shore Preservation Act is divided into two parts. Part one regulates the construction, reconstruction, or other physical activity undertaken specifically for shore protection purposes. This regulation is accomplished by requiring that a permit be obtained from the State Board of Conservation prior to the commencement of such work if it will affect the sovereign lands of Florida below the mean high water line of any tidal water of the state. Part two provides for the division of the state into beach and shore preservation districts and includes the grant of a general power of authority to the administrators to effectively carry out the purpose of this chapter. The Board of county commissioners of any county and its successors in office, as an ex officio duty, are designated as the beach and shore preservation authority for their county. The chapter contains 31 sections and is quite detailed in its enumeration of authority and duties. (R. Smith-Fla)
W69-00511

EFFECT UPON OWNERSHIP AND TAXABILITY OF LANDS - AFFECTED BY ACCRETION, EROSION OR AVULSION.
Rep Att'y Gen Fla, 063-50, May 20, 1963.

Descriptors: *Florida, *Avulsion, Erosion, Riparian rights, Riparian land, Local governments, State governments, *Beach erosion, Bank stability, Coastal engineering, Water law, Ownership of beds, Boundaries (Property), Oceans, Coast, Shores, Beaches.

In reply to certain questions posed, the Attorney General stated that the status of the fee title of an area which formerly was upland, but which now consists of submerged lands, is determined by the manner in which the land became submerged. The Florida courts have adopted the legal principle that where the upland is lost by reason of avulsion and the effect is perceptible, there is no boundary change. If the property was lost by a slow and imperceptible process there would be a boundary change and the title to the submerged area would be vested in the state. Since the land in question has become submerged through both erosion and avulsion, the city, in its efforts to regain beaches through the construction of groins, cannot extinguish the riparian rights of the upland owners affected by such works, and thus it should not undertake such a project until those private upland owners have consented to such a program. (Smith-Fla)
W69-00512

RIPARIAN RIGHTS AND DUTIES,
Vincent Powell-Smith.
The Law J, Vol 115 (NS), No 5171, pp 155-157, March 5, 1965. 3 p, 3 ref.

Descriptors: Water law, *Riparian rights, Artificial watercourses, Reasonable use, *Natural streams, Civil law, *Repulsion (Legal aspects), Percolating water, Surface drainage, Industries, Damages.
Identifiers: *United Kingdom, Common law.

A succinct summary of English water law respecting riparian rights and duties is presented, including case citations and references to Roman and civil law influences. Rights of extraction and use are part and parcel of the natural incidents of ownership. The question of industrial use as an ordinary and reasonable use remains undecided. The landowner is under no common law duty to do anything to correct a natural stream flowing through his land that becomes obstructed by natural causes; however, actions in nuisance, negligence and strict liability may lie in cases where injury stems from nonnatural causes. (MacMillan-Fla)
W69-00513

MCGIBNEY V WAUCOMA YACHT CLUB INC (DOCKS - RIPARIAN LAND).

182 A 2d 622-625 (S Ct Err Conn 1962).

Descriptors: *Connecticut, Navigable waters, Riparian rights, *Docks, Marinas, Littoral, *Riparian land, Rivers, Banks, Damages, Water law, Prescriptive rights.

The defendant for about forty years has owned land on the westerly bank of the river, abutting land which the plaintiff, between 1935 and 1952, leased from Ball and which he purchased from Ball in 1952. Continuously since 1935, the plaintiff has operated on this property a restaurant which has increasingly through the years received patronage from rivercraft. In 1955, the plaintiff built a small dock which he extended by adding floats until, by 1960, he had a 'T' dock on the river in front of his property. The defendant has operated a yacht club since 1930. In 1960, the defendant erected a string of floating docks parallel to the shore and about 112 feet out therefrom. Later defendant ran a dock perpendicularly from the shore out to the string of floating docks. The effect of these actions was to block direct access from the main river channel to the plaintiff's property. The court held that even though plaintiff failed to prove facts from which the trial court could assess the monetary amount of his damages, the trial court was entitled to grant injunctive relief against the tortious interference with plaintiff's littoral rights. (R. Smith-Fla)
W69-00514

UNITED STATES V 461.42 ACRES OF LAND (AVULSION AS IT RELATES TO TITLE).
222 F Supp 55-59 (N D Ohio 1963).

Descriptors: Ohio, Judicial decisions, Lake Erie, Dikes, Riparian waters, Riparian land, *Ownership of beds, United States, Condemnation, Eminent domain, *Avulsion, Beds, Storms, *Beach erosion, Waves (Water), Erosion.

This was a proceeding to determine title to land appropriated by the United States. The State of Ohio and defendant claimed title and the United States sought a judicial clarification of title so that payment for the appropriated land might be made. The land in question had been submerged in Lake Erie since 1929, and Ohio claimed title based on a statute which provided that title to land under Lake Erie would be in the State. Defendant claimed title based on the fact that prior to 1929 the land was above water and became submerged by avulsion after a violent storm. There is an Ohio statute which provides that title shall not be lost by avulsion. Ohio claimed that the storm in 1929 was simply a factor aiding in the erosion of the land, and that land lost by erosion will extinguish title. The land was held to have been lost by avulsion and title remained in the defendant. (Crabtree-Fla)
W69-00515

REORGANIZATION PLAN NO 2 OF 1966 (WATER POLLUTION CONTROL).
U. S. Congress, House Committee on Government Operations, 89th Congress, 2nd Session.

Hearings, Subcommittee of the Committee on Government Operations, House of Representatives, 89th Congress, 2nd Session, March 30 and May 4, 1966.

Descriptors: *Legislation, Administrative decisions, *Political aspects, Water resources development, Administrative agencies, *Water pollution control.
Identifiers: Water Pollution Control Acts.

On March 30, 1966 the Subcommittee of Executive and Legislative Reorganization of the Committee on Governmental Operations House of Representatives met to consider Reorganization Plan No 2 of 1966. The subcommittee heard testimony and received additional material for the record. The Plan would amend the Federal Water Pollution Control Act (33 U S C 466). Basically, the Plan would transfer to the Secretary of the Interior the functions delegated to the Department of Health, Education, and Welfare, under the Federal Water Pollution Control Act except for responsibilities relating to public health. The purpose of the reorganization is to unify water pollution control efforts with the related tasks of managing, developing, and conservation, of water resources which are functions of the Department of the Interior. Objections to the Plan included a possible deemphasis on the public health aspect and unnecessary delay in the implimentation of the Federal Water Pollution Control Act. On May 4, 1966, the subcommittee reconvened to consider H Res 827, a resolution of disapproval of Reorganization Plan No 2 of 1966. The subcommittee heard additional testimony. The subcommittee discussed the effects which the reorganization would have on the employment status of the commissioned officers of the Public Health Service. No action was taken on the resolution. (Molica-Fla)
W69-00516

RECENT DEVELOPMENTS IN RESOURCES AND UTILITIES LAW,
E. F. Taylor.
AWWA J, Vol 56, No 7, pp 863-880, July 1964. 18 p, 44 ref.

Descriptors: *Water law, *Water supply, *Water resources development, *Project planning, Legislation, Judicial decisions, Legal aspects, Water allocation (Policy), Federal-state water rights conflicts, Interstate compacts, Water rights, Federal government, State government, Water rates.

The major developments in water resource laws and programs are considered in the article. One of the most significant developments was the Supreme Court decision authorizing the Secretary of Interior to exercise previously unparallelled powers over the Colorado River's water supply in times of shortage. The author considers the Secretary's plan for managing the river, along with international water resource control plans such as the Great Lakes Water Resources Plan and the Columbia River Basin Compact, and regional plans such as the Delaware River Basin Compact. The problem of federal-state conflicts is examined and Congressional recommendations and judicial decisions in the area are considered. The author then surveys the recent water rights litigation throughout the country. Various states have passed or are considering water resource development programs and plans. The author considers these and state problems in the utilities area. (Horner-Fla)
W69-00517

AN ACT RELATING TO THE WATER AND AIR ENVIRONMENTAL IMPROVEMENT COMMISSION.
Maine Laws Ch 475 (July 5, 1967).

Descriptors: *Main, Legislation, Air pollution, Rivers, Standards, *Water reservoirs, Grants, Sludge, *Sewage treatment, Hydrogen-ion concentration, Sea waters, *Water pollution, Administrative decisions, Administration, Administrative agencies, Water law.

The Water and Air Environmental Improvement Commission's purpose is to recommend methods of controlling pollution of air, rivers, waters and coastal flats caused by municipal sewage, industrial wastes and other materials detrimental to the public health or public use. The Commission recommends that the legislature raise water quality standards when economically feasible. The Commission can accept federal funds for water pollution, water resources and air pollution control. The Commission has four standards for the classification of fresh surface waters and five standards for the classification of tidal or marine waters. The Act describes these classes and the limits and requirements for the use of each. A schedule for compliance to water standards for users of certain waters of the Penobscot River Basin and Waldo County is provided. Methods for enforcing these standards and procedures for appealing Commission decisions are established. The Commission is also required to make studies relating to the causes and prevention of air pollution. (Childs-Fla)
W69-00518

AN INTERSTATE APPROACH TO WATER POLLUTION ABATEMENT,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00519

APPLICATION OF 253.122 F S TO SUBMERGED LANDS OWNED BY ONE OTHER THAN THE ABUTTING UPLAND OWNER,
Richard Ervin.
Rep Att'y Gen Fla 059-191, Sept 25, 1959.

Descriptors: *Florida, Administrative agencies, Adjudication procedure, Administrative decisions, *Beds, Ownership of beds, State governments, Contracts, Jurisdiction, *Legislation, *Bulkhead lines, Permits, Coastal structures, Landfills.

This opinion responded to questions from a trustee of the internal improvement fund involving one's right to fill submerged lands: (1) purchased from one abutting upland owner, or (2) purchased with consent of the abutting upland owner, and (3) such owner's duty to comply with the Bulkhead Law. The trustee also asked if a full record of proceedings setting a bulkhead line was required. The Attorney General replied that even though prior to 1957 an owner of submerged land had a statutory right to bulkhead and fill such lands, and this was a contract right, such contract right could be impaired in persuance of the state's police power. He concluded that the passage of the 1957 Bulkhead Law was an exercise of the police power, that it did impair contract rights, and therefore owners of submerged lands in both cases posed in the questions must comply with the Bulkhead Law, regardless of when they or the persons under whom they claimed acquired the lands. He also stated that a full record of proceedings setting bulkhead lines was necessary. (R. Williams-Fla)
W69-00520

WATER RIGHTS LITIGATION,
Edward F. Taylor.
AWWAJ, Vol 58, No 5, pp 535-554, May 1966. 20 p, 54 ref.

Descriptors: Droughts, Water conservation, Interstate, Water supply, *Delaware River Basin Commission, *Interstate compacts, State governments, Municipal water, *Water permits, Riparian rights, Prior appropriation, Water pollution control, *Long-term planning, Local governments.
Identifiers: Water impasse, Model Water Use Act.

The drought that seized the Northeast in 1965, and which regularly seizes the West, pointed out the need for water laws of national and regional scope but more importantly, for farsighted local plans. The states of New York, New Jersey and Delaware launched long-range attacks on the problem of water supply and conservation through the Delaware Basin Commission. Local government's primary responsibility is to protect and develop water supplies. Determining who has priority is the key in developing comprehensive rules to govern the use of water. The Model Water Use Act is a major aid in water-law revision as it incorporates the most workable provisions of many state and local systems. Western water law is the article's main topic. (Geraghty-Fla)
W69-00521

BASS V FARRELL (TITLE TO ACCRETED LAND).
Arkansas, Little Rock.

370 S W 2d 54-59 (Ark 1963).

Descriptors: Erosion, *Channel erosion, Bank erosion, *Acretion (Legal aspects), Boundaries (Property), Lumber, meanders, Currents (Water), Shores, Riparian land, Maps, Judicial decisions, *Arkansas, Areal.

Involved in this dispute between riparian owners are concepts of erosion and accretion. Defendant was enjoined from cutting timber on land formed by accretion. The appellate court upheld the injunction because the defendant, as the real plaintiff in this suit, did not sustain the burden of recovering on the strength of his own title. The appellate court did not consider defendant's numerous exhibits persuasive of his claim. The apportionment portrayed in the exhibits was untenable. It is common knowledge that a bank is eroded by the pressure of the current against the shoreline. Aerial photographs showed discernable lines of erosion on the upstream site only, indicating that the channel did in fact travel downstream from west to east. This negated defendant's assumption that the accretions in issue were formed as the river moved from the north to the south. (Harriett-Fla)
W69-00522

VILLAGE OF OLD FIELD V SCHUYLER (LICENSE TO DREDGE ON STATE SUBMERGED LAND).
13 N Y 2d, 191 N E 2d 460-464 (1963).

Descriptors: *Dredging, Channel improvement, *Navigation, Navigable waters, Jurisdiction, Federal jurisdiction, State jurisdiction, *Permits, Administrative agencies, Legislation, *New York.

The appellant realty company owned land fronting on Long Island Sound. This included two jetties extending into the Sound, which had been constructed by the predecessor in title persuant to an easement from the State. The appellant sought to dredge between the jetties. This necessitated obtaining a license from the Land Office. The statute requiring the license required Certification by the Army Corp of Engineers that dredging was necessary to improve navigation. Respondent argued an appeal that the State had no authority to issue the license, since certification had not been obtained. The Court of Appeals disagreed. It reasoned that the Corp of Engineers, when issuing the permit to dredge, tacitly understood the purpose to be improvement of navigation. Failure of the permit to specify navigation did not preclude the State from issuing its license. (Harriett-Fla)
W69-00523

BURKART V CITY OF FORT LAUDERDALE (RIPARIAN RIGHTS).
156 So 2d 752-766 (Fla DCA 1963).

Descriptors: *Florida, Judicial decisions, *Riparian rights, Navigable waters, *Accretion (Legal aspects), Land tenure, *Easements, Right-of-way, Public rights, Highways, Access routes.

Owners of lots in a subdivision brought suit against the city of Ft Lauderdale, Florida, to resolve the question of ownership of riparian rights. The lots were bounded by a street that ran along a navigable stream. The court held that where a street was laid out so that it was bounded on one side by navigable waters, dedication of the street to the public operated to relinquish to the public and merge into the public right dedicator's individual right of access to the open navigable waters in front of the dedicator's uplands. Owners of upland were not vested with riparian rights to the exclusion of the riparian rights accruing to the easement for the street even though they owned the underlying fee in the street. The dissent urged that riparian rights should not be treated, as here, as an indivisible package of privileges attached exclusively to the easement, and that plaintiffs should be adjudged owners of the land formed by accretion with such riparian rights and privileges as do not burden the easement according to the purpose of its dedication. (MacMillan-Fla)
W69-00524

STATE V KULUVAR (CHANGE IN CROSS-SECTION OF PUBLIC WATERS).
123 NW 2d 699-707 (Minn 1963).

Descriptors: Permits, Federal jurisdiction, International boundaries, State jurisdiction, Reservation doctrine, Federal-state water rights conflicts, *Legislation, Judicial decisions, *Minnesota.
Identifiers: *Criminal law.

Defendant was convicted for violating a Minnesota criminal statute prohibiting interference with public waters subject to state control without authorization. The Supreme Court of Minnesota rejected two arguments for reversal, but accepted a third. The court rejected first the assertion that there was a conflict between federal and state authority. There was no showing that compliance with the State statute interfered with federal exercise of power over an international boundary. The court also rejected plaintiff's argument that the statute was too uncertain to be constitutional. The court did declare, however, that in order to justify the conviction, it must be established that the use of the waters, past, present, or reasonably likely in the future, has been detrimentally affected by the unlicensed change. Evidence of such detrimental effect was lacking. (Harriett-Fla)
W69-00525

FLOOD CONTROL REGULATIONS.

33 CFR Part 208, Jan 1, 1968.

Descriptors: United States, Cost allocation, Maintenance costs, Project planning, State governments, *Flood control, Flood protection, *Flood routing, Levees, Sand boils, *Dams, Reservoirs, Drainage, Channels, Bank protection, Riprap, Seepage, Right-of-way, *Regulation, Engineering.

Structures constructed by the U S for local flood protection shall be continuously operated and maintained by states or political subdivisions thereof, who furnish assurances that they will do so in accordance with regulations prescribed by the Secretary of the Army and without cost to the U S. They shall appoint permanent committees, headed by 'Superintendants' who will be responsible for the operation, maintenance and inspection of such facilities. Before improvements or repairs of project works are undertaken, a superintendant must contact the District Engineer of the Dept of the Army. The superintendant must also submit semi-annual reports to the District Engineer. Maintenance and operation procedures are outlined to insure the serviceability of levees, drainage structures, pumping plants, channels, floodways and other flood control facilities. The Upper Potomac River Commission is responsible for the operation of the Savage River Dam and Reservoir. Operating instructions are detailed in the chapter, including a Storage Reservation Diagram. Responsibility for the operation of the Alpine Dam and Reservoir, the Bear Creek Dam and Reservoir and the Weiss Dam and Reservoir are also described in detail. Much of the chapter deals with the operation of dams and reservoirs in western states, notably California. The publication is kept up to date by annual supplements. (Geraghty-Fla)
W69-00526

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
Fla Admin Code, Ch 285, Secs 28-5.01 to 28-5.21.

Descriptors: Permits, *Florida, *Legislation, Administrative agencies, State jurisdiction, Water law, State governments, *Water pollution treatment, Water pollution control, Water quality control, Pollution abatement, *Drainage wells, Water pollution, Water quality, Industrial wastes, Municipal wastes, Standards.

The rules included in this chapter deal with the pollution of waters within the territorial limits of the State of Florida. The rules enumerate the standards of water quality desired and provide for the testing procedures to be used to insure compliance with the standards. The waters of the state are divided into five classifications and detailed criteria are provided for ascertaining the degree of purity required of each class. The rules state it is the intent of the State of Florida to review Class V stream classifications periodically and as water quality improves, hearings will be held and reclassification shall be established. The rules also provide for the regulation of drainage wells. (R. Smith-Fla)
W69-00528

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
Fla Admin Code, Ch 285, Secs 28-5.01 to 28-5.04.

Descriptors: Permits, *Florida, *Legislation, Administrative agencies, State jurisdiction, Water law, State governments, *Water pollution treatment, Water pollution control, Water quality control, Pollution abatement, Water pollution, Water quality, Industrial wastes, Municipal wastes, Standards.

The following minimum conditions are applicable to all Florida waters, at all places and at all times. Within the territorial limits of this state all such waters shall be free from: (1) settleable substances, (2) floating substances, (3) deleterious substances, and (4) toxic substances. Tests or analytical procedures to determine compliance or noncompliance with water quality criteria provided by this chapter shall be in accordance with methods given in the latest edition of Standard Methods for the Examination of Water and Wastewater. All industrial wastes or other wastes shall be effectively treated by the latest modern technological advances as approved by the regulatory agency. All discharges from municipal and privately owned domestic waste plants will comply with the Water Quality Standards of the State of Florida with 90% treatment or better as expeditiously as possible, but not later than Jan 1, 1973. (R. Smith-Fla)
W69-00529

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
Fla Admin Code, Ch 285, Secs 28-5.05 to 28-5.21.

Descriptors: Permits, *Florida, *Legislation, Administrative agencies, State jurisdiction, Water law, State governments, *Water pollution treatment, Water pollution control, Water quality control, Pollution abatement, *Drainage wells, Water pollution, Water quality, Industrial wastes, Municipal wastes, Standards.

The rules also set 21 quality control standards to provide the criteria for determining the degree of pollution. The waters of Fla are classified according to their usage as follows: (1) Class I - public water supplies; (2) Class II - shellfish harvesting; (3) Class III - recreation and the propagation and management of fish and wildlife; (4) Class IV - agricultural and industrial water supply; and (5) Class V - navigation, utility and industrial use. The above classifications are discussed in detail as to the criteria of each and the classifications are reviewed periodically. The rules also provide for the regulation of drainage wells. Before any municipal or private corporation or persons shall use an existing drainage well or drill a new well for the discharge of surface water or sewage, it must apply to the Commission for a written permit authorizing the drilling and use of said well. (R. Smith-Fla)
W69-00530

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.
16 USCA Secs 791-797 (1968).

Descriptors: *United States, *Legislation, *Federal Power Act, Public lands, Reservation, City, Navigable waters, Projects, *Water resources, Permits, Hydroelectric project licensing, Reservoirs.
Identifiers: Federal Power Commission, Powersites.

This act establishes the Federal Power Commission. The composition of commission and the restrictions placed on commissioners are detailed. The Commission employs a chief engineer and other officers. Public lands, reservations, corporations, person, state, municipality, navigable waters, municipal purposes, government dam, project, project works, commission, state commission and security are defined. The Commission's general powers are: (1) investigations and data collection on water resources, the water-power industry, power sites and power from government dams: (2) statements of license investment in projects; (3) cooperation with the executive department; (4) publication of information and reporting to Congress; (5) license issuance for construction of dams, reservoirs, etc.; (6) issuing preliminary permits; (7) investigating occupancies developing power. Preliminary permits are not transferable and are subject to cancellation. Licenses are valid for fifty years. The controls over permits are explained. There are limitations on license transfer. (Childs-Fla)
W69-00531

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.

16 USCA Secs 798-806 (1968).

Descriptors: *United States, *Federal Power Act, Legislation, Navigation, Right-of-way, Sluices, Locks, Dams, *Navigable waters, Monoply, Channel, Projects, Permits.
Identifiers: Amortization reserves, Public use.

Conditions imposed on FPC license include: (1) the project adopted must be the best for developing a waterway for public use; (2) alteration of the approved project is allowed only in emergencies; (3) the project must be maintained; (4) amortization reserves must be maintained; (5) reimbursement is to be paid by a benefited licensee; (6) other consistent conditions may be required; (7) monopolistic combinations are prohibited; (8) certain of these conditions may be waived. Project work affecting navigable waters may have additional conditions included in their license: (1) if the project is a dam then the construction of locks, booms, sluices, etc, may be required; (2) if these are not to be constructed by the licensee, then the right of way is to be given to the United States; (3) the licensee is required to furnish the power for these structures. If navigation requires additional construction but the cost is unreasonable, then the commission will request Congress to participate. The licensee must commence construction within two years from licensing and proceed with due faith and diligence. The Attorney General may act to secure a license revocation and the sale of unfinished works. (Childs-Fla)
W69-00532

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.

16 USCA Secs 807-823 (1968).

Descriptors: *United States, Legislation, *Federal Power Act, *Permits, Compensation, Coast Guard Regulations, State regulation, *Rates, Channel, Eminent domain, Navigable waters, Public lands, Reservations.
Identifiers: National safety, Secretary of the Army, Navigational facilities, Public service licensees.

When an FPC license expires, the Government may acquire the works upon payment of compensation equal to the net investment. Licenses may be renewed. The Government may use projects when necessary for the national safety and upon payment of compensation. Provision is made for disposing of charges arising from licenses. The Coast Guard may direct the maintenance of lights and signals. The Secretary of the Army regulates navigational facilities. Penalties are prescribed for non-compliance. All public-service licensees must abide by state regulation, unreasonable, discriminatory and unjust rates are prohibited for interstate power. When property is necessary for the public interest to develop a waterway, it may be acquired through eminent domain. Rights vesting prior to June 10, 1920 are not affected. It is unlawful to maintain works affecting navigable waters, public lands, reservations or use surplus water or water power from a Government dam except under certain conditions. A license is required for works affecting interstate or foreign commerce. The Attorney General may act to prevent license violations. This chapter does not affect state law relating to water used for irrigation or other purposes. This act is annotated and supplemented. (Childs-Fla)
W69-00533

BODICK V HARCLIFF MINING CO (OBSTRUCTION TO STREAMFLOW BY MINING WASTES).

208 Pa Super 471, 222 A 2d 615 (1966).

Descriptors: *Pennsylvania, Remedies, Adjudication procedure, *Flood damage, *River flow, *Obstruction to flow, Ice jams.

A trespass action was brought for damages to plaintiff's house, located 300 feet from the edge of the Allegheny River. Plaintiff alleged that debris from defendant's strip mine, consisting of the remains of a spoil wall which had slid into the river channel approximately 1/2 mile downstream, interfered with the normal flow of the river causing an ice jam, unusually high flood waters, and the resultant damage to his home. After verdict for plaintiff, defendant moved for judgment N O V and for a new trial, both of which were denied. This Court affirmed, holding that whether the debris interfered with the normal flow of the river was a jury issue. There was sufficient evidence of proximate cause to submit the matter to the jury. Defendant's negligence may be the proximate cause of an injury where it is a substantial factor in bringing about the injury or when it concurs with an act of nature and defendant cannot show that the injury would have occurred independently of his negligence. (Kahle-Fla)
W69-00534

KNIGHT V CIARLONE (INTERFERENCE WITH LITTORAL RIGHTS).
200 NYS 2d 805-807 (1959).

Descriptors: *Judicial decisions, *New York, *Riparian land, Riparian rights, Docks, *Easements.
Identifiers: Injunctions.

Defendants had an easement over plaintiffs property for the purpose of gaining access to a lake upon which plaintiff was a littoral owner. Defendants constructed a dock extending into the lake from plaintiff's property. Plaintiff brought suit to compel defendants to remove the dock. The Chancellor stated that a littoral owner on a lake has not only title to the low-water mark of the lake, but as an appurtenance or easement thereto, he has a right of access to and from the lake waters and to build such docks as will not interfere with navigation. The Chancellor held that defendant's easement did not include the right to construct a dock and that such construction interfered with plaintiffs' littoral rights. The injunction was granted. (R. Williams-Fla)
W69-00535

STEBBINS V ORANGEBURG MFG CO (STREAM POLLUTION).

10 App Div 2d 859; 199 NYS 2d 124-125 (1960).

Descriptors: *New York, Judicial decisions, Streams, *Damages, Pollution abatement, *Water pollution, Chemical precipitation, Waste treatment, Riparian rights.

Plaintiff property owner sought an injunction and damages for pollution of a creek adjacent to his property by defendant's discharge of industrial wastes. The New York Supreme Court, Appellate Division, held that evidence sustained finding that industrial waste discharged by defendant caused the creek to be below the standard of purity required by water pollution control board and caused emission of chemical odor constituting a nuisance and entitling owner to damages. Denial of the injunction was proper because of the installment by the defendant of a chemical treatment plant. (MacMillan-Fla)
W69-00536

RANDLE V CITY OF ROME (MUNICIPAL LIABILITY FOR STORM DRAINS).
195 NYS 2d 373-376 (1960).

Descriptors: *Judicial decisions, *New York, *Cities, Drains, Surface runoff, Surface drainage, *Storm drains, Obstruction to flow, Water injury, Floods.

Plaintiff property owner brought an action against the city, alleging negligence in its operation of storm drains, resulting in the backing up of water in the street and on plaintiff's property. The city moved to dismiss the complaint. The court held that notice of a defective condition did not have to be given to the city under such a provision in its charter, where the city creates a dangerous condition through its active negligence. The judge summarized New York on municipal liability for water damage and concluded that where a city has undertaken to provide a drainage system, negligence in the operation and repair of such system will render the municipality liable for damages. The court held that the plaintiff's complaint stated a cause of action and denied the city's motion to dismiss. (R. Williams-Fla)
W69-00537

FAIRCHILD V KRAEMER (PUBLIC RIGHTS IN TIDAL MARSHES).
193 NYS 2d 512-514 (1959).

Descriptors: *Judicial decisions, *New York, *Navigation, *Tidal marshes, Easements, Ownership of beds, Tidal waters, Harbors.

Plaintiff held title to part of a sound, which had consisted, prior to 1893, of sand ridges, salt marshes and tidal creeks. Around 1893 the area was dredged so as to become a deep, commonly used harbor for pleasure craft. In 1959, plaintiff hired a watchman and challenged those who wished to enter the harbor. He brought an action of trespass against defendant, claiming title to the bottom of the harbor because it was man-made. The court held that the area was always subject to the public's navigation rights since tidal creeks opened into the sound. Generally all salt waters where the tide ebbs and flows are navigable in law, giving rise to a right of navigation vested in all the people. This is true even though the tidal creeks may not be actually navigable at low tide. Judgment was rendered for defendant. (R. Williams-Fla)
W69-00538

SMITH V PEOPLE (LANDS APPROPRIATED FOR STATE RESERVOIR).
193 NYS 2d 127-130 (App Div 1959).

Descriptors: *Judicial decisions, *New York, State governments, *Reservoirs, Islands, Eminent domain, Compensation, Condemnation, *Maps.
Identifiers: Adverse possession.

Plaintiff brought an action to quiet title to part of an island in a state reservoir. Plaintiff contended that the strip of land which connected the island to the mainland was covered by water only in the spring. Thus the strip was a peninsula and not part of the land appropriated by the state for the reservoir. The map filed when the award was made to plaintiff's predecessor in title showed the land as included in the appropriation. A New York Statute provided that such award maps are presumptive evidence of state ownership. The Supreme Court, Appellate Division, affirming a judgment for the State by the trial court, held that plaintiff had not overcome the presumption of state ownership. The court additionally held that since the state constitution forbade the disposal of any canal lands unless no longer in use and because these lands were held in trust for the public, the state could not have alienated them. Plaintiff's claim to title through adverse possession was barred. Alienability is a prerequisite for operation of adverse possession. (R. Williams-Fla)
W69-00539

MARANDOLA V BEAUREGARD (FLOODING OF LOWER LAND).

158 A 2d 876-877 (R I 1960).

Descriptors: *Judicial decisions, *Rhode Island, *Floods, Streams, Obstruction to flow, Water injury, *Pipes.
Identifiers: Evidence.

Complainants owned land below that of respondents. A natural watercourse had flowed from time

immemorial from a pond on respondents' land across complainants' land. Complainants filled in their land and enclosed the watercourse in a pipe, which had a bend in it and which did not follow the natural course of the book. This pipe became blocked and flooding of complainants' land and a town highway resulted. Complainants contended that the respondents caused this flooding by deepening the drainage ditch from the pond and filling in such pond. Complainants brought suit to enjoin respondents from further excess discharge and to recover for damages already suffered. The trial court found that the complainants had been the cause of the flooding, and dismissed the bill. The Rhode Island Supreme Court affirmed. (Williams-Fla)
W69-00540

ALLEN V MORRIS BUILDING CO (SURFACE RUNOFF DAMAGE).

360 Mich 214; 103 NW 2d 491-493 (1960).

Descriptors: *Michigan, Judicial decisions, Surface waters, Surface runoff, *Repulsion (Legal aspects), *Riddance (Legal aspects), Drainage water, Damages.

Homeowners in Michigan sued a building company and its majority stockholder and president for damages caused by water flowing onto their land as a result of grading and construction. The supreme court held that the fact that defendants willfully graded and built downspouts causing waters in excess of natural flowage to be channeled onto plaintiffs' property causing damage was enough to warrant recovery without negligence or violation of city ordinance. Plaintiffs were not required to raise the grade of their lot to mitigate damages. Where an individual, who is majority stockholder, president and in control of defendant corporation's activities personally supervised such grading and construction, he participates in the tort and is personally liable with the corporate defendant. (MacMillan-Fla)
W69-00541

REKEDALL V COUNTY OF REDWOOD (DITCHES).
102 NW 2d 682-689 (Minn 1960).

Descriptors: *Minnesota, *Ditches, Legislation, State governments, Drainage, *Assessments, Benefits, Compensation.

The petitioners sought to use Judicial Ditch No 33 as an outlet for the proposed Judicial Ditch No 32. The district court granted authority and fixed the benefit to Judicial Ditch No 32 at $12,500. The property owners who had been assessed to pay for No 33 sought appeal from the order claiming that the $12,500 only paid for actual changes to No 33 to enable No 32 to use it and it did not include any of the cost of the original construction of number 33. The Supreme Court held that the district court and not a jury had the power under MSA 106.531, to fix the terms and conditions for the use of a ditch as an outlet. The court held that the landowners were not an aggrieved party entitled to appeal the court decision under MSA 106.631. That section only provided for appeal when benefits were assessed upon landowners for the construction of a ditch. That was not the case here since the landowners were not being assessed. (Horner-Fla)
W69-00542

ESSOCK V TOWN OF COLD SPRING (DRAINAGE DITCH).
10 Wis 2d 98; 102 N W 2d 110-114 (1960).

Descriptors: *Drainage, *Ditches, *Assessments, Legislation, Local governments, Legal aspects, Wisconsin.

The plaintiff landowner brought action to set aside a special assessment made upon his land for cleaning out a drainage ditch contiguous to the land. The court held that the town board complied with the statute outliving procedures on complaint of obstruction and the statute outliving the manner of apportionment of assessments. The board's action was not arbitrary or unreasonable and its determination is conclusive. (Horner-Fla)
W69-00543

FLYNN V BEISEL (RIPARIAN RIGHTS).
102 N W 2d NW 2d 284-293 (Minn 1960).

Descriptors: *Riparian rights, *Easements, *Riparian land, Navigable waters, Ownership of beds, Boundaries (Property), Real property, Water law, Legal aspects.

The plaintiff sought to enjoin the defendants from erecting a dock at the termination of a public easement abutting on a navigable lake. The plaintiff admitted that the public has easement rights of ingress to and egress from the lake but alleges that the rights are restricted to travel only and not to use of navigable waters beyond the water's edge. The court held that the roadway to the lake had been established by common law dedication and therefore the public had the same riparian rights as any riparian owner. Riparian rights are an incident of ownership of the shore and not ownership of the bed of a lake. Riparian owners have a right to make use of a lake over its entire surface, in common with all other abutting owners, provided such use is reasonable and does not interfere with the rights of abutting owners. (Horner-Fla)
W69-00544

OAKLAND CLUB V CITY OF SOUTH EUCLID (SURFACE RUNOFF).
165 NE 2d 699-703 (Ohio Ct App 1960).

Descriptors: Municipalities, Drainage systems, Water law, Repulsion (Legal aspects), *Controlled drainage, Drainage, Drainage water, Large watersheds, Judicial decisions, Riparian waters, *Storm drains, Storm runoff, Surface runoff, *Surface drainage, *Ohio, Sewers, Reasonable use, Running waters, Surface water, Diffused surface water.
Identifiers: Capacity of the stream rule, Civil law rule.

Plaintiff maintained a golf course for the use of its members. A natural watercourse flowed through that land serving to drain surface water accumulating in the general area. Taking advantage of this natural watershed area and several small tributaries that ran into the watercourse, defendant municipality constructed a stormwater sewage system to collect and dispurse surface water from municipal land adjacent to the golf course. Plaintiff alleged that defendant's drainage system burdened the watercourse beyond its natural capacity causing the golf course to flood in times of heavy rainfall. Plaintiff contended that, under the capacity-of-the stream rule, the defendant may in the reasonable use of its land drain water from the land into its natural outlet and thus increase the volume and accelerate the flow without incurring liability; but it may not do this beyond the capacity of the watercourse in its natural drainage. Noting that such was not the rule in this jurisdiction, the court held that defendant could collect into sewers the surface water which comes from a watershed area within its borders and discharge it into such watercourse without liability to the plaintiff even though in so doing incidental damage occurred to the plaintiff. (Kuder-Fla)
W69-00545

EBERLE V GREENE (OBSTRUCTION OF SURFACE WATER FLOW).

18 Ill 2d 322; 163 NE 2d 822-826 (1960).

Descriptors: Control, Dams, Water control, *Drainage, Surface drainage, Surface waters, *Illinois, Judicial decision, Water law, *Surface runoff, Water rights, Obstruction to flow.
Identifiers: *Civil law rule.

The plaintiffs, servient landowners, brought an action to enjoin neighboring dominant landowners from obstructing the flow of surface water over their property. The court held that when surface water naturally flowed from the property of the defendants due to the contour of the land, the plaintiffs had a right to have the flow of surface water continue unimpeded. A dam built by the defendants to prevent flow was ordered torn down, with the court holding further that an order to return the boundary to its natural state was sufficiently clear. However, the plaintiffs had the right to build a dam on their property if it did not impede the flow of surface water onto the land of others or change the natural course of drainage. (Headley-Fla)
W69-00546

SHEEHAN V RICHMOND COUNTY (EMINENT DOMAIN AND HIGHWAY DRAINAGE).

100 Ga App 496, 111 SE 2d 924-927 (1959).

Descriptors: Drainage, Drainage systems, *Eminent domain, Tile drainage, Storm runoff, Ponding, Flooding, *Surface runoff, Drainage effects, Surface drainage, *Easements, Georgia, Third party effects.

Plaintiff sued the county to recover damages to his property caused by flooding and ponding water on his property as a result of the highway being so constructed as to expel large quantities of water through water traps and gutters at given points. The highway drainage system for the drainage of rain water from the road had recently been constructed incident to other highway improvements. The continuous channeling of surface water across property to its damage amounts to the taking of an easement over the lands. This falls under the state constitutional provision requiring adequate compensation for property taken or damaged for a public purpose. The fact that plaintiff's property did not abut the highway, as property owned by others was situated between, does not defeat plaintiff's right to recovery. (McDermott-Fla)
W69-00547

MISSISSIPPI STATE HIGHWAY COMM'N V PETERSON (FAIR VALUE IN EMINENT DOMAIN PROCEEDINGS).
117 So 2d 452-454 (Miss 1960).

Descriptors: *Judicial decisions, *Mississippi, *Eminent domain, *Condemnation value, Compensation, Condemnation, Water wells.
Identifiers: Evidence.

This case involved an eminent domain proceeding in which the State Highway Commission condemned a strip of appellees' land. Such taking would include two shade trees and cause damage to a well, which was the only good well in the area. The jury rendered a verdict for $4,200, while the testimony of experts was all to the effect that the damage was less than $1000. However, these witnesses did not consider the shade trees or the well in their estimations. On appeal to the Mississippi Supreme Court, the court held that the verdict was grossly excessive and that such damages were not shown by proper evidence. The court stated that damages could not be recovered by appellees' for losses suffered by neighbors who had used the well. The case was reversed and remanded for a new trial. (R. Williams-Fla)
W69-00548

BERTRAM V STATE ROAD DEPARTMENT (CONSTRUCTION OF BRIDGE OVER WATERWAY).

118 So 2d 674-675 (3d DCA Fla 1960).

Descriptors: Florida, *Remedies, Channels, Water law, *Adjudication procedure, Public rights, Riparian rights, Judicial decisions, Water rights, Inland waterways, *Relative rights, Bridge construction.
Identifiers: Marine interests, Intercoastal waterways.

Plaintiffs, a large number of marine interests, sought a declaratory decree, injunction and other relief to prevent construction of a fifty-five foot vertical clearance fixed span bridge across the intercoastal waterway in Biscayne Bay, Dade County, Florida. This court affirmed the circuit court's dismissal of the complaint for failure to state a cause of action. Plaintiffs right to use the waterway was no greater than that of the public at large since they were not riparian owners. Since special damages different from that inflicted on the public at large were not alleged the plaintiffs stated no cause of action. (McDermott-Fla)
W69-00549

FURTEK V WEST DEER TOWNSHIP (SURFACE DRAINAGE).

19 Pa D and C 2d 169-181 (Com Pl 1959).

Descriptors: Agricultural watersheds, *Drainage systems, Drainage, Ditches, Drainage water, Runoff, Storm drain, Storm runoff, Surface drainage, Surface runoff, *Drainage effects, *Repulsion (Legal aspects), Drains, Soil erosion, Judicial decision, *Pennsylvania, Cities.
Identifiers: Trespass.

The plaintiff brought an action in trespass against the defendant township to recover damages to plaintiff's land allegedly resulting from the closing of a surface drain in a highway. The action of the defendant diverted diffuse surface waters from other areas of natural drainage and caused them to be discharged upon the plaintiff's land, thus increasing the area of the watershed drainage over his premises. The court held that although the plaintiff was required to fight the common enemy as best he could, he was not required to bear more than his share of the burden. The township had no right to cause drainage from other watershed areas to be discharged upon the land of the plaintiff so as to increase the amount of drainage over his property. (Kuder-Fla)
W69-00550

JONES V TOMAN (COMMON-ENEMY DOCTRINE OF SURFACE WATERS).

60 Lack Jur 217-222 (Pa Com Pl 1959).

Descriptors: Water law, *Pennsylvania, Drainage effects, *Surface runoff, Surface waters, Damages, Soil erosion, Alluvion, Relative rights, Judicial decisions, Surface drainage, Runoff, *Repulsion (Legal aspects).
Identifiers: *Common-law rule.

Defendants, neighboring landowners to plaintiffs, filled in a portion of their land. The raised level of their land resulted in surface water and alluvial soil flowing onto the land of the plaintiffs. Defendants acted to improve the drainage conditions of their property. Plaintiffs now suffer a similar problem and are suing to compel its correction and to enjoin this condition from continuing. The common-law rule, or 'common-enemy' doctrine, prevails in Pennsylvania. Thus one may use his property as he pleases and fend off surface waters without taking into account the consequences to other landowners. Since water is descendible by nature, the owner of a dominant or superior heritage has an easement in the servient or inferior tenement for the discharge of all waters which by nature rise in or flow or fall upon the superior. This is true even if alluvial soil is taken along and deposited on another's land. Liability exists only where the owner of the higher land is guilty of negligence which causes unnecessary damage to his neighboring landowner, or where by an artificial channel he collects and discharges surface waters in a body or precipitates them in greatly increased quantities upon his neighbor. Plaintiffs' complaint was dismissed and judgment entered for the defendants. (McDermott-Fla)
W69-00551

MICHAELSON V SILVER BEACH IMPROVEMENT ASS'N INC (OWNERSHIP OF ACCRETION).

173 N E 2d 273-280 (Mass 1961).

Descriptors: *Accretion (Legal aspects), *Massachusetts, Real property, *Riparian rights, *Riparian land, Ownership of beds, Low water mark, Mud flats, Boundaries (Property), Easements, Judicial decisions.
Identifiers: Artificial accretion.

The plaintiff riparian land owner brought suit to enjoin the defendant bathing society from using a beach created by the Commonwealth in front of the plaintiff's land. Under Massachusetts law riparian ownership extends to the low water mark and where accretions are made to land along the seashore, the line of ownership follows the changing water line. The accretion did not have to be due to natural causes for the rule to apply. In some cases, however, where the Commonwealth creates lands as an incident of its power to improve navigation the title belongs to the Commonwealth. In this case there was no showing that the lands were formed as a result of a project to improve navigation and the usual rules of accretion apply even though the land was entirely created by the Commonwealth. (Horner-Fla)
W69-00552

YEZIORO V NORTH FAYETTE COUNTY MUNICIPAL AUTHORITY (RIGHT TO CONTINUED SERVICE FROM PUBLIC UTILITY).

193 Pa Super 271; 164 A 2d 129-144 (1960).

Descriptors: *Utilities, Water works, Public utilities, Water distribution (Applied), Profit, Water conveyance, Judicial decision, *Public rights, Water conveyance, Pennsylvania, Water rates, Pipelines.

This was an appeal from a decree enjoining the municipal authority from discontinuing water service to several customers. Public consumers had attached individual service lines to a private line owned by the local school board. When the school board discontinued service to its building, the authority threatened to stop all service to that private line unless the consumers agreed to take responsibility for the line. The Appellate Court, in affirming the trial court, said that abandonment of service cannot be justified solely on the basis of the private nature of the line. The court also held that public use, inconvenience and hardship to the public, and availability of a substitute service must be weighed against the authority's loss of profits. The court further stated that it was the duty of the authority to provide safe, reasonable service to the public for reasonable and uniform rates. (Sisserson-Fla)
W69-00553

VERMONT WOOLEN CORP V WACKERMAN (WATER POLLUTION ABATEMENT).
167 A 2d 533-541 (Vt 1960).

Descriptors: Vermont, *Water pollution control, Classification, Judicial decisions, Public health, *Legislation, Change orders, Administration, Installation costs, Costs, Riparian rights, Industrial wastes, Industrial plants.
Identifiers: *Police power.

Plaintiff, an industrial corporation, appealed an order of the state conservation board which classified waters adjoining plaintiff's plant as beyond Class D, those that contain sewage or industrial waste to the point of nuisance. Plaintiff attacked the constitutionality of the legislation that gave the conservation board the power to issue such classification orders. The court, in upholding the legislation's constitutionality, stated that the promotion of the public welfare and the providing of the maximum of beneficial use and enjoyment of the waters of the state to its people is a proper exercise of police power. In answer to the plaintiff's complaint of the unreasonable cost of installing equipment to prevent further pollution, the court said that strongly favored policy considerations will outweigh burdensome cost even if financial hardship is placed on a particular individual. The court also said that the board must furnish reasonable notice of its classifications. (Sisserson-Fla)
W69-00554

TOWNSHIP OF HATFIELD V LANSDALE MUNICIPAL AUTHORITY (RIGHT TO PERCOLATING WATERS).

403 Pa 113, 168 A 2d 333-334 (1961).

Descriptors: *Percolating water, *Water wells, Groundwater, Water supply, Water table, *Water rights, Water law, Legal aspects, Water utilization, Equitable apportionment, Reasonable use.

Plaintiff sought to enjoin the defendant municipality from operating its well because a trial run caused dehydration of some surrounding wells and a dimunition in water supply in others. The issue was whether there is a right of absolute appropriation of percolating waters. This court affirmed the trial court's holding that there is no absolute right to appropriate percolating waters where the water is diverted for sale to others away from the land. The trial court was within the broad powers of a court of equity in ordering the municipality enjoined unless it joined to its system without cost all interested injured parties within a radius of 1600 feet from the well. (Horner-Fla)
W69-00555

WILLIAMSTOWN V RUBY (RIGHTS UNDER EASEMENTS).
336 S W 2d 544 (Ct App Ky 1960) 336 SW 2d 544-547 (Ky 1960).

Descriptors: *Kentucky, Judicial decision, *Easements, Competing uses, Access routes, Dams, Public rights, *Property disputes, Usufructuary right.
Identifiers: *Retained rights.

Appellee conveyed an easement to the Department of Fish and Wildlife Resources which was subsequently assigned to appellant city. The easement granted the right to build and maintain a dam on or adjoining appellee's land and create a pool of water thereon. It also granted the right of ingress and egress over a fifty foot strip of appellee's property. The city sought an injunction to stop appellee from trespassing on the fifty foot strip and from operating and renting motorboats for use on the lake. Appellant maintained that it had the right to exercise absolute dominion over it's lake and over the strip of land. The court held that the city took only those rights that were granted in the easement. The rest were retained by the grantee. The easement was granted for the use and enjoyment of the facilities of the dam and the lake by fisherman. The appellee was, therefore, entitled to use the land for any purpose which did not interfere with the proper enjoyment of the easement. (Sisserson-Fla)
W69-00556

CONRAN V GIRVIN (TITLE TO ACCRETION).

341 S W 2d 75-104 (Mo 1960).

Descriptors: *Accretion (Legal aspects), *Riparian land, *Riparian rights, Real property, *Avulsion,

Bank erosion, Boundaries (Property), Low water mark, Ownership of beds, Channels, Islands, Legislation, Water law, Judicial decisions.
Identifiers: Evidence.

Plaintiff claimed title to an island which had formed in the Mississippi River adjacent to the defendant's riparian land. A state statute gave counties title to islands formed inside the county and the plaintiff held title under a patent from the county. In Missouri, riparian owners hold title to the low water mark. Evidence showed that the land did not form in the river from that part of the bed to which the state had retained title and hence the title never rested in the county. Therefore the plaintiff's patent did not convey title. The evidence showed that the nucleus of the island was originally accretion on the plaintiff's land which was above the low water mark of the river. Then the accretion grew and a channel was cut between it and the mainland. When the river cuts a new channel, not by eroding away the intermediate lands but by jumping over them leaving a part of the land of a riparian owner intact and identifiable then the title to that land so cut off remains in the riparian owner. (Horner-Fla)
W69-00557

ADAIR V FRISBY (DAMAGES FROM SALT WATER DISCHARGE).
State of Arkansas, Little Rock.

345 SW 2d 468-469 (Ark 1961).

Descriptors: Judicial decisions, *Arkansas, Discharge (Water), *Saline water, Encroachment, Property values, *Water pollution effects, Damages, Overflow, Streams.

Appellees sought damages for the discharge of salt water by appellants into a creek which flowed through appellee's property. The only issue on appeal was whether the judgment was excessive. Appellee testifird that prior to the damage his entire tract of 177 acres was worth $17,000; after the damage was done, the land was worth $10,000. He also introduced evidence that the salt water killed timber, causing it to fall and clog a creek which flowed across his land, thereby overflowing 54.5 acres of the property, reducing such acreage in value from $100 per acre down to $25 or $30 per acre. This damage alone would have amounted to around $4,000, and there was evidence that it would have cost more than $4,000 to clear the creek of fallen timber. Appellants' evidence tended to show that the damages did not exceed $900. On these facts, the court held that the award of $2,375 damages was not excessive, and affirmed the judgment. (Smodish-Fla)
W69-00558

CITY OF DANVILLE V SMALLWOOD (COMPENSATION FOR RETROACTIVE CONDEMNATION).
347 SW 2d 516-520 (Ky 1961).

Descriptors: Judicial decisions, *Kentucky, Condemnation, Cities, *Compensation, Diversion, Storm runoff, Damages, Obstruction to flow, Washouts, Foundation failure, Storm drains.
Identifiers: Restoration.

The City of Danville constructed a storm sewer and in so doing blocked off a former channel which carried off rain water. Water was then forced into a concrete pipe which ended in front of plaintiffs' residence. Dirt piled at the end of the pipe formed an obstruction to the flow of the water. A very heavy rainfall occurred after the city had been notified of the condition, but before any damage had been done. The dirt obstruction caused an unnatural diversion of the water onto the yard of plaintiffs' home and so undermined the foundation of the house that large portions of it collapsed. The yard was also severely washed and damaged. The court held that the facts constituted 'a condemnation suit in reverse,' or 'a retroactive condemnation of land,' and that the City of Danville had to pay compensation to plaintiffs for loss of the use of the home and restoration costs. (Smodish-Fla)
W69-00559

BOARD OF COM'RS V ST LANDRY PARISH SCHOOL BD (COMPENSATION BY STATE FOR TAKING LAND).

130 So 2d 692-696 (Ct App La 1961).

Descriptors: *Louisiana, Judicial decisions, *Condemnation, *Compensation, Levees, Navigable waters, Flood control, Mississippi River, Public rights, Land tenure, State governments.
Identifiers: Constitutional law.

The Louisiana Court of Appeal affirmed a decision in favor of a parish school board in a declaratory judgment action to determine whether a levee board was required to pay a parish school board $182 for lands actually used for a right-of-way for levee and levee drainage purposes. A servitude was found to exist in favor of the public on lands in Louisiana adjacent to navigable rivers and streams for the purpose of constructing and repairing levees to confine the waters of such watercourses. The State may appropriate riparian lands burdened with this servitude without prior judicial proceedings and without compensation for the actual value. The court held that the landowner was entitled to compensation for actual value where, as here, the land was not taken for purposes of confining overflow but rather in aid of the overall diversion of the excess water of the entire Mississippi Valley. This included artificial diversion of waters into floodways or other routes outside the major channel of the Mississippi. (MacMillan-Fla)
W69-00560

NORTH DADE WATER CO V ADKEN LAND CO (ENJOINING LAKE POLLUTION).

130 So 2d 894-899 (3d DCA Fla 1961).

Descriptors: *Florida, Judicial decisions, *Sewage effluents, Pollution abatement, Lakes, *Water pollution, Water law.

An owner of land surrounding two landlocked lakes sought to enjoin defendants from discharging water and sewage effluent through a conduit into the lakes. He claimed that such action constituted a private nuisance (odors and pollution of lakes) and a continuing trespass resulting in irreparable damage for which there was no adequate remedy at law. The Florida appellate court held that the owner was entitled to an injunction where no right to discharge into the lakes had been reserved. The additional expense in discharging into a creek rather than the lakes did not excuse or justify defendant's actions. (MacMillan-Fla)
W69-00561

ROLLAN V POSEY (BOUNDARY LINE DISPUTE).
126 So 2d 464-469 (Ala 1961).

Descriptors: *Boundaries (Property), Real property, *Non-navigable waters, *Ownership of beds, Streams, Tidal waters, Water law, Legal aspects, Riparian rights, Riparian land, *Alabama.

Complaintants and respondents dispute the ownership of land described in both their deeds. The respondent claimed the 40 acres contained in the SE quarter of the NW quarter of Section 12. A non-navigable stream flows through the northern part of the plot. The complaintants' land is to the north of the respondents' and is described as running to the stream. The disputed land lies between the northern boundary of the SE quarter of the NW half and the stream running south of that boundary. The court held that the owner of land bounded by a non-navigable stream owns to thread of the stream. This was the true boundary because the plaintiff had been in possession originally and his title was not disturbed by the respondents adverse possession. (Horner-Fla)
W69-00562

AMERICAN MORTGAGE CORP V LORD (TITLE TO ACCRETIONS).
132 So 2d 40-42 (2 DCA Fla 1961).

Descriptors: *Accretion (Legal aspects), Real property, Boundaries (Property), Riparian lands, Riparian rights, Water law, Legal aspects, Judicial decisions.

The question was whether accreted lands were passed by a deed conveying certain government lots. The lands were described in two ways in the deed. One part said certain lots were conveyed and the other said all of the named lands lying in a certain township. Unless excepted the title to accretions passes with the title to the land to which the accretions are appurtenant. The court held there was no conflict between the descriptions and in neither were the accretions excepted. The accretions passed with the land. (Horner-Fla)
W69-00563

WATER PERMITS IN MARYLAND.
Maryland Laws, Ch 415 (1967).

Descriptors: *Maryland, *Legislation, Administrative agencies, *Water allocation (Policy), Water consumption, *Permits, Water permits, Water law, Water utilization.

This act added a new section to Article 96 A of the Annotated Code of Maryland, title 'Water Resources,' subtitle 'Appropriation of Water; Reservoirs and Dams.' The new section authorized the Department of Water Resources to review existing required water usage permits to ascertain that appropriation and use was in accord with the permit. The permits could be corrected if the appropriated amounts of water were not or did not have to be used. (Sisserson-Fla)
W69-00564

RULES OF CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT.
Fla Admin Code, Chapter 152, 1968. 29 p.

Descriptors: *Administrative agencies, Budgeting, *Florida, Inter-agency cooperation, Local governments, Planning, Project planning, Regulation, Water districts, *Flood control, Public benefits, Tax rate, Drainage districts, Eminent domain, Permits, Right-of-way, Recreation facilities, Relocation, Political constraints.
Identifiers: Cooperative emergency construction, *Flood control district, Secondary works, Spoil policy, Flood control account.

The District's authority, power, and organization are outlined. It must plan and provide for District works and facilities and cooperate with the federal government and other governmental agencies whenever possible. It has the power of eminent domain. Attention must be paid to recreational uses of District works. The policy for the issuance of permits for the use of District land and works is outlined. General construction requirements are provided for in a separate District publication. Rules are established for the cooperative emergency construction program whereby non-District projects may acquire District assistance. Secondary works may be undertaken in emergency situations. Procedure for acquiring rights-of-way is outlined. The disposal of surplus lands and policy with regard to the relocation of privately owned facilities are provided for. Spoil policy is outlined. Financial procedure, including a flood control account in the general revenue fund and the power to levy a uniform ad valorem tax of up to 1 mill on all property in the District, is established. Officers and employees of the District are prohibited from engaging in political activity. (McDermott-Fla)
W69-00565

LEGAL ASPECTS OF WEATHER MODIFICATION-SNOWPACK AUGMENTATION IN WYOMING,
Wyoming Univ, Laramie.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00612

ORGANIZATIONAL ARRANGEMENTS FOR WATER DEVELOPMENT,
Resources for the Future and Department of Conservation, School of Natural Resources, University of Michigan.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00616

LAW OF WATER RESOURCES OF THE STATE OF MISSISSIPPI,
Mississippi State Univ., State College, Coll. of Law.
Parham Williams.
Rep, Water Resour Res Inst, Miss State Univ, June 1966. 23 p, 30 ref. OWRR Project A-006-Miss.

Descriptors: *Water laws, *Mississippi, *Legal aspects, Riparian rights, Water utilization, Water resources, Watercourses (Legal).

The object of this report was to determine the problems created by the conflicting claims to water use and control in Mississippi, to explore how these conflicting interests have been protected by legislative act, judicial decision and administrative regulation, and to formulate recommendations, where warranted, for legislation and regulations necessary to achieve the desirable objectives.
W69-00661

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M University, College Sta, Texas Agricultural Experiment Station.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00676

6F. Nonstructural Alternatives

DESIGN AND CONSTRUCTION OF A DUAL RECHARGE SYSTEM AT MINOT, NORTH DAKOTA,
U S Geological Survey, Bismarck, North Dakota.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00433

CONFLUENCE ANALYSES OF LAND SURFACES,
Wyoming Univ., Laramie, Eng. Coll.
Michael R. McGaw.
Water Resour Res Inst, Water Resour Series 7, Univ Wyoming, Aug 1967. 49 p, 21 fig, 4 tab, 3 ref. OWRR Project A-001-Wyo.

Descriptors: Analysis, Coordination, Data storage and retrieval, Documentation, River basins, Watersheds (Basins).

A systematic method of deriving a set of regional coordinates is proposed for coordinating water resource activities. It analytically sub-divides a continent into those successively smaller-order confluent and multifluent regions in which surface waters are naturally interrelated. Possible applications of the system, together with resulting surface-water coordinates for the state of Wyoming are presented.
W69-00671

6G. Ecologic Impact of Water Development

PROCEEDINGS SYMPOSIUM ON ESTUARINE ECOLOGY COASTAL WATERS OF NORTH CAROLINA.
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00460

07. RESOURCES DATA

7B. Data Acquisition

ELECTROMAGNETIC MAPPING OF HAWAIIAN LAVA TUBES,
Hawaii Univ, Manoa.
David von Seggern, and William M. Adams.
Tech Rep 8, Water Resour Res Center, Univ Hawaii, Aug 1968. 27 p, 13 fig, 9 ref. OWRR Project B-005-Hi.

Descriptors: Electromagnetic waves, Radio waves, Hawaii, Surveys, *Geologic mapping, Geological surveys, Subsurface investigations, Hazards, Subsurface waters, *Lava.
Identifiers: *Electromagnetic surveying, *Lava tubes.

A portable, electromagnetic loop-coupling device has been built to locate points on the earth's surface over points in an underground cavity and determine the depth to the cavity. This method requires both an underground and a surface operator who each carry a motorcycle battery, a 20-in.-dia loop antenna, and a compact transceiver circuit. The underground unit transmits to the surface a 1200 hz signal, essentially unattenuated and undistorted. The surface operator locates the transmitter by a nulling procedure. Three methods of determining depth are described. The accuracy of the location and the depth determination with the loop-coupling device is checked with a transit survey. The device was applied with success to Kaumana Lava Tube on the island of Hawaii. Locations confirmed suspicions that the tube ran under roads and buildings. The roof of the tube was found to average about 25-ft thick. Accuracy of a compass-and-tape survey 4400 ft into the tube was checked by locations with the loop-coupling method and found to be in error by 20 ft. Lava tubes are significant as conduits of water and as geologic hazards.
W69-00403

MEASUREMENT OF PRECIPITATION OVER LAKE MICHIGAN,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-00406

BRIDGER TELEMETRY COMMUNICATIONS SYSTEM,
Montana State Univ., Bozeman, Water Resour. Res. Center.
Robert. A. Leo.
Rep 5 of Proj 779 (See W69-00453 and W69-00454), Jan 1967. 23 p, 13 fig. OWRR Proj B-006-Mont.

Descriptors: *Telemetry, *Communication, Electronic equipment, Data transmission, Instrumentation, *Radio communication systems, Antennas, Maintenance, Montana, Research facilities, Frequency modulation, Experimental data.
Identifiers: Bridger Data Center, Mont.

The Bridger Telemetry Communications System provides Frequency Modulation (FM), Very High Frequency (VHF), radio equipment in order to transmit digital hydrometeorological data from the Bridger Mountain area north of Bozeman, Montana, to the Electronics Research Laboratory on the campus of Montana State University, Bozeman, Montana. Either voice or data mode may be used. The voice mode may be used to communicate in both directions over the link for maintenance purposes and in normal operation is very seldom used. The data mode provides for transmission on 171.9 MHz of digital data in 1 direction only--from Bridger to ERL. The system accepts digital data (gathered and processed by other Bridger area equipment and facilities, and described in other reports) in the Transmitter Control Unit located at the Bridger Recording Center. This report lists events regarding the system; a description of the individual units; a description of the field-strength measurement experiments; plus an appendix consisting of block diagrams, schematics, and experimental data.
W69-00452

BRIDGER HYDROMETEOROLOGICAL RESEARCH AREA AND FACILITIES,
Montana State Univ., Bozeman, Water Resour. Res. Center.
For primary bibliographic entry see Field 09C.
For abstract, see .
W69-00453

BRIDGER HYDROMETEOROLOGICAL DATA ACQUISITION SYSTEM,
Montana State Univ., Bozeman, Water Resour. Res. Center.
Lee E. Cannon.
Rep 6 (Joint Rep 779) (See W69-00452 and W69-00453), Feb 1967. 39 p, 4 fig, 8 drwgs, 26 ref. OWRR Proj B-006-Mont.

Descriptors: On-site data collections, *Electronic equipment, *Data collections, *Data transmission, Meteorological data, Operations, Digital recording systems, *Instrumentation, Calibrations, Transducers, Computer programs.
Identifiers: Digitizers, Scanning.

The Data Acquisition system (DAS) installed at Bridger Bowl was designed and constructed to record a wide variety of hydrometeorological parameters in a computer compatible form. The DAS system is described in detail giving characteristics, operating instructions, and complete information on all components. Appendices offer illustrations and drawings of the terminal board functions, system cabling, and schematics.
W69-00454

WATER-LEVEL PROBE,
National Reactor Testing Station, Idaho Falls, Ida.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00591

A VERSATILE, GAS-OPERATED WATER-LEVEL RECORDER,
Institute of Northern Forestry, Juneau, Alaska.
A. E. Helmers.
Water Resour Res, Vol 4, No 3, pp 619-623, June 1968. 5 p, 4 fig.

Descriptors: *Liquid level gages, Instrumentation, Costs, Gases, Rain gages, Measuring instruments, *Bubbles, Hydrostatic pressures, Nitrogen, Wells, Pressure regulators, Recording systems, *Water stage recorders, Water table, Ground water, Piezometers, Sensors.
Identifiers: *Bubbler system, Water level, Probes (Instruments), Water wells.

A low-cost, gas-operated, water-level recorder is described. The device operates on the basis that the pressure required to bubble gas freely through a liquid is a function of depth. Commercially available gas-operated, water-level recorders are expen-

sive; parts and materials for the described recorder cost less than $200. Water level changes of 0.05 in. can be detected in the laboratory, and under field conditions the maximum sensitivity is 0.1 in. Recorders of this type are highly successful for measuring water levels in piezometers and storage precipitation gages, and appear adaptable to recording stream stages and ground-water levels. (USBR)
W69-00597

BRIDGER INSTRUMENT MODIFICATION,
Montana State Univ., Bozeman.
Duain Bowles.
Water Resour Res Center Rep 2, Sept 1966. 30 p, 15 fig, 2 tab. OWRR Project B-006-Mont.

Descriptors: Instrumentation, *Measuring instruments, Thermometers, Calibrations, Potentiometers, Gages, *Water levels, *Rain gages, Equipment.

The instrument modifications described in this report are intended for use in the Water Resources Bridger Data System. Specifically, the modifications were designed to permit electrical interrogation of existing devices now being operated at the research area. The modifications were to provide a resistive readout of 10 K ohms or operate as a potentiometer. Ideally the modifications would not degrade instrument performance and would permit operation of the instrument as a direct analog recording device. Modifications were designed for operation on the Belfort Universal Raingage, the Leopold Stevens Water Level Recorder, and the Belfort Recording Microbargraph. In addition, thermistor thermometers were constructed to operate at the research areas thermograph locations. Calibration tests were conducted to verify that the instrument modifications met the design requirements.
W69-00643

METHOD OF VOLUME-DIVERSION ANALYSIS OF A STREAM,
U S Geological Survey, Washington, D. C., Water Resources Division.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00694

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND-WATER TRACERS,
Texas A and M University, College Station, Texas.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00701

7C. Evaluation, Processing AND Publication

MAP INTERPRETATION AND CLASSIFICATION OF BURIED VALLEYS,
Massachusetts Univ, Amherst.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00437

THE USE OF EIGENVECTORS FOR CLIMATIC ESTIMATES,
Nevada Univ., Reno.
Charles K. Stidd.
Univ Nevada, Desert Res Inst, Preprint Series 36, July 1966. 28 p, 4 fig, 4 tab, 6 ref. OWRR Project B-008-Nev.

Descriptors: Estimating equations, Probable maximum precipitation, Hydrologic cycle, *Approximation method, Reliability, *Mathematical models, Precipitation (Atmospheric), Climatology.
Identifiers: *Eigenvectors, *Orthogonal functions, Precipitation estimates.

Eigenvectors have an advantage over mathematical orthogonal functions in that they are derived from the data being studied and strongly resemble the important features of the data. The process is described by which a matrix of eigenvectors was derived from the sets of 12 mean monthly precipitation values for 60 stations in Nevada. The first 3 eigenvectors (in order of importance) were found to account for 93% of the variance in the original 12 x 60 matrix of raw data and are also found to have features in common with 3 natural cycles of annual precipitation in Nevada. The station multipliers, corrected to a mean elevation, are plotted and analyzed on 3 maps. The method is tested by using it to estimate long-term means for a period of time not included in the input data. Standard errors using the maps and eigenvectors are smaller than for estimates based directly on the short-term station means. Estimates for stations not used in the original input had standard errors small enough to be acceptable. It can be claimed that for a given point in Nevada, the eigenvector method will give as reliable an estimate of the 12 monthly average precipitation amounts as could be obtained from an actual 10-yr record.
W69-00644

08. ENGINEERING WORKS

8A. Structures

UNITED STATES V GRAND RIVER DAM AUTHORITY (FEDERAL FLOOD CONTROL UNDER COMMERCE CLAUSE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00470

AUTOMATED ANALYSIS OF GRID BEAM SYSTEMS,
Iowa State Univ, Ames.
Hotten A. Elleby.
Eng J Amer Inst Steel Constr, Vol 5, No 3, pp 123-127, July 1968. 5 p, 3 fig, 2 tab, 1 chart, 5 ref, append.

Descriptors: Flow diagrams, *Stress analysis, Structural engineering, *Structural analysis, Structural design, Structural members, Boundaries, *Automation, Beams, Moments, Shear stress, Continuous beams, Continuous structures, Programs, *Grid systems, Trusses, Optimum design, Computer programming, Deformation.
Identifiers: Matrix methods (Structural), Computer programs, Boundary Conditions.

An exact solution to a beam grid system can be obtained using Clapeyrons 3-moment equation which can be derived from slope deflection equations. Two unknown quantities per node point are required for the general solution rather than 3 for slope deflection equations. Two boundary conditions are considered: a free boundary where beams are used to support interior members, and a grid system that is continuous over interior supports. The method is divided into 3 phases to simplify computer input. Analysis of a uniformly loaded grid roof system supported at the corners illustrates the use of this method. The method was developed for beam-type members such as wide-flange sections of plate girders, but 2-way truss analysis is responsive where the upper and lower chords are continuous sections and the shearing deformation of the trusses is known to be negligible. A flow chart for the computer program is given. (USBR)
W69-00576

HYDRAULICALLY CONTROLLED BUTTERFLY GATES IN FARM LATERAL TURNOUTS FOR AUTOMATION OF SURFACE IRRIGATION SYSTEMS,
Howard R. Haise, E. Gordon Kruse, and Leonard Erie.
Pap 68-244, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 14 p, 12 fig, 5 ref.

Descriptors: *Turnout gates, *Automatic control, Irrigation practices, Irrigation systems, *Laterals, *Gates, *Butterfly valves, Automation, Hydraulic gates and valves, Floats, *Ditches, Plastic tubing, *Surface irrigation.
Identifiers: Farms, Arizona.

An automatic irrigation system was used experimentally to irrigate 10 ac of citrus grown on the coarse-textured Superstition fine sand on the Yuma Mesa in Arizona. A major objective in designing the system was the use of existing farm laterals and turnouts, adapting automated features to them at the lowest cost. The automatic system consists of (1) a source of water at 60-70-psi pressure, (2) solvent-welded 3/4-in. PVC pipe to distribute the water under pressure at selected locations along the farm lateral, (3) 4-way hydraulically controlled pilot valves operating double-acting water cylinders to open and close butterfly gates in turnouts, and (4) sumps with sinking floats to operate 3-way control valves when surface inflow of irrigation water occurs at a predetermined point within the border strip. The automatic system is completely hydraulic, deriving its operating pressure from a pump driven by a water wheel mounted in the flowing water used to irrigate the land. (USBR)
W69-00588

8B. Hydraulics

TWO DIMENSIONLESS GROUPS RELEVANT IN THE ANALYSIS OF STEADY FLOWS OF VISCOELASTIC MATERIALS,
Delaware Univ., Newark, Chem. Eng. Dept.
Gianni Astarita.
I and EC Fundamentals, Vol 6, pp 257-262, May 1967. 6 p, 25 ref. OWRR Project A-005-Del.

Descriptors: *Steady flow, Analysis, *Two-dimensional, *Viscous flow.
Identifiers: *Viscoelasticity, Flow patterns.

Five flow patterns (viscometric flow, pure shear, elongational flow, fourth-order flow, and a superposition of the first two) are analyzed. The behavior of fluids characterized by an essentially exponential rate of stress relaxation in such flows is discussed. The discussion leads to the introduction of 2-dimensionless groups relevant for steady flows.
W69-00626

FLOW OF VISCOELASTIC FLUIDS THROUGH POROUS MEDIA,
Delaware Univ., Newark.
R. J. Marshall, and A. B. Metzner.
I and EC Fundamentals, Vol 6, No 3, pp 393-400, Aug 1967. 8 p, 3 fig, 1 tab, 50 ref. OWRR Project A-005-Del.

Descriptors: Bibliographies, *Viscous flow, Flow, *Porous media, Experimental data, *Fluid friction, Flow resistance, Permeability, Analysis.
Identifiers: *Viscoelasticity, Deborah number, Test results.

This work was undertaken to define the conditions under which the Deborah number may become large enough to cause significant deviations from the usual drag coefficient-Reynolds number relationships for purely viscous fluids flowing through porous media under noninertial conditions. The analysis suggests that major effects may be expected at Deborah numbers from 0.1 to 1.0. Experimental studies, using a porous medium, support this analysis and yield a critical value of the Deborah number at which viscoelastic effects were first found to be measurable. Influences of a high Deborah number level upon the uniformity of the flow and upon the distribution of the fluid residence times in porous media are considered.
W69-00627

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., New Jersey.

For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00629

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., Princeton, N. J.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00630

A NUMERICAL SOLUTION OF THE EQUATIONS OF MOTION AS APPLIED TO SURFACE FLOW,
New Mexico State Univ., University Park.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00636

8C. Hydraulic Machinery

RECENT PROGRESS IN THE FIELD OF SYNTHETIC TESTING OF CIRCUIT-BREAKERS,
P. Heroin, J. C. Henry, and C. Marty.
Pap 13-11, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 19 p, 17 fig, 10 ref.

Descriptors: *Circuit breakers, *Test procedures, Extra high voltage, Statistics, Test facilities, Stress, Experimental data, Characteristics, Probability, Electric currents, Electric potential, Fluorides, Research and development, Electric arcs, Mathematical analysis, Sulfur compounds, Performance tests, Dielectrics.
Identifiers: *Airblast circuit breakers, *Synthetic test methods, Test results, France, Foreign research, Short circuits, *Sulfur fluorides.

With transmission voltages becoming higher and higher, new methods are required for testing circuit breakers at these higher voltages and currents. Research has been undertaken in France to develop and explore the current injection synthetic test methods and to gain better knowledge of circuit breaker phenomena. Numerous statistical tests were performed on two types of circuit breakers (airblast and sulfur hexafluoride) to compare direct testing methods with synthetic testing methods. The general methodology for testing circuit breakers is discussed. Results of asymmetrical current tests on an airblast circuit breaker are given. A satisfactory method is described for prolonging the test beyond the first zero. Phenomena related to high and low restriking during shortcircuit tests on a sulfur hexafluoride circuit breaker are studied. Investigations of the low probability of the reignition point showed that the percentage of reignitions at the first zero obeyed a Gaussian law for percentage values between 0.6 and 95%. Synthetic tests were concluded to be the best method for testing airblast and sulfur hexafluoride circuit breakers. (USBR)
W69-00570

NEW EXPERIENCES DURING EIGHT YEARS OF TOWER TESTING AT THE LECCO STATION (ITALY),
Societa Anonima Elettrificazione SpA, Milan, Italy.
M. Finzi, and G. Magenta.
Pap 22-03, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 7 p, 6 fig, 1 tab.

Descriptors: Structural analysis, *Transmission towers, Design tools, *Design criteria, Test procedures, *Test facilities, Experimental data, Steel structures, Aluminum alloys, Compression, *Towers, Dynamometers, Fabrication, Live loads, Dead loads, Tolerances (Mechanics), Extra high voltage, *Guyed towers.
Identifiers: *Test results, Testing equipment, Testing, Loading tests, *Lecco Station, Italy, Foreign research, Slenderness ratio.

Experience gained during the past eight yr of transmission tower testing at Italy's Lecco test station is reported. The test station and facilities for testing ehv towers are described. Results of tests on guyed and aluminum towers are discussed. Compression formulas proposed by the American Society of Civil Engineers in its Aug 1967 report 'Electrical Transmission Line and Tower Design Guide' have been verified experimentally. The verification ascertains the correctness of the proposed formulas and the high success probability of load tests performed on structures designed according to the ASCE design criteria. (USBR)
W69-00571

FIVE-YEAR RESEARCH PROGRAM IN ULTRA-HIGH VOLTAGE,
General Electric Co, Schenectady, N Y; Pennsylvania Electric Co, Jamestown.
L. O. Barthold, and P. L. Lumnitzer.
Pap 42-04, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 7 p, 4 fig, 1 tab.

Descriptors: Transmission towers, *Contamination, Corrections, *Extra high voltage, Research and development, Test facilities, *Transmission lines, Test procedures, Design, Instrumentation, *Radio interference, *Electrical coronas, Electric insulation, Laboratory tests, Lightning, Losses, Transmission (Electrical).
Identifiers: *Ultra high voltage, Electrical insulators, Switching surges, Electrical design, Testing equipment, Electric conductors.

Significant conclusions reached at Project EHV in Pittsfield, Mass, during the 1965-66 ehv program are described, and the facilities and program for extending this research to voltage levels up to 1500-kv ac are outlined. New information cited includes: (1) switching surge strength of insulator-tower configurations, (2) air-density and humidity correction factors for long insulator assemblies, and (3) electrical strength of contaminated insulators. The 1967-71 program will initially use cages to simulate the field surrounding short sections of ultra-high-voltage conductors. A single-phase transformer will be used in 1969 to energize full-scale conductor and insulator configurations suitable for voltages of 1000 to 1500 kv. Testing of artificially and naturally contaminated insulators will include superposition of switching surges on 60-cycle voltage. Ultra-high-voltage systems of 1000 to 1500 kv technically are feasible for overlay of 500- and 765-kv systems; however, economic application will depend on refinements and innovations in transmission design such as form the objectives of the Project Ultra-High Voltage Program. (USBR)
W69-00572

CORONA IN POWER TRANSFORMERS,
Industrie Elettriche di Legnano, Italy; McGraw-Edison Power System Division, Milwaukee, Wis; Ferranti Ltd, Great Britain.
S. Yakov, C. C. Honey, and A. B. Madin.
Pap 12-06, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 11 p, 9 fig, 6 tab, 13 ref.

Descriptors: *Power transformers, *Electrical coronas, Oscillographs, Detection, *Electric insulation, Methodology, Instrumentation, Research and development, Radio interference, Static electricity, Dielectrics, Ultrasonics, Measurement, Laboratory tests, Electrical engineering, Oils.
Identifiers: Protection (Electrical), Insulating oil, Insulation, Dielectric properties.

Detection methods capable of indicating small partial discharges in complex insulation structures of power transformers during dielectric tests are available to manufacturers and users. Experiments are presented using three widely publicized corona detecting techniques: (1) the NEMA Noise Meter for measuring changes in voltage, (2) the charge detector for measuring charge displacement, and (3) the ultrasonic detector for measuring acoustic disturbances. A summary is given of test data obtained on samples and models of transformer insulation structures. These data may answer some questions relative to corona in transformers. Many problems remain unsolved and the answers will come only through publication and discussion by the industry of test results. (USBR)
W69-00573

TRANSIENT VOLTAGES CAUSED BY THE OPERATION OF CIRCUIT-BREAKERS IN HIGH-VOLTAGE SYSTEMS: SWITCHING OVERVOLTAGES WHEN CLOSING LINES AT NO-LOAD AND TRANSIENT RECOVERY VOLTAGES WHEN INTERRUPTING FAULTS CLOSE TO TRANSFORMERS.
Brown Boveri and Co, Baden, Switzerland; Sprecher and Schuh, Aarau, Switzerland.
H. Glavitsch, E. Ruoss, and R. Thaler.
Pap 13-05, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 14 p, 12 fig, 2 tab, 4 ref.

Descriptors: Extra high voltage, *Circuit breakers, Transients, Power transformers, Test procedures, *Transmission lines, Networks, Frequency, Faults (Electrical), Investigations, Electrical impedance, Stress, Test facilities, Electric potential.
Identifiers: *Switching surges, *Overvoltage, Switzerland, Flashover, *Short circuits, Overhead ground wire, Foreign research.

The problems concerning high-voltage circuit breakers discussed have more significance with the increase of rated voltage and short-circuit capacity of high-voltage networks. An understanding of these problems is essential for economic design of high-voltage systems and equipment. The first problem concerns the overvoltages that occur when energizing a transmission line at no-load by a circuit breaker. The influence of different network and line parameters on the magnitude of switching surges is shown, and the frequency of overvoltage occurrence depending on different circuit breaker parameters is examined. Nonsimultaneous closing of the 3 poles of a circuit breaker is considered. Voltages of lines studied were 245-, 420-, and 765-kv. The second problem involves transient recovery voltage and natural frequencies when interrupting a short circuit at the terminals of a circuit breaker, the fault being fed from a network by transformers. Recovery voltages with frequencies up to 30 khz and an amplitude factor of 1.8 to 1.9 may occur. A recommendation is given for laboratory simulation of this stress on a circuit breaker during test. (USBR)
W69-00574

DEVELOPMENT OF ROTATING RECTIFIER EXCITERS,
UCE Linalux-Hainaut, Belgium; Ateliers de Constructions Electriques de Charleroi, Belgium.
P. Robert, P. Bawin, and J. Dispaux.
Pap 11-05, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 17 p, 17 fig, 6 tab, 4 ref.

Descriptors: *Excitation, *Semiconductors, Magnetic fields, Leakage, Design, *Rectifiers, Electric power, Electric currents, Electric fields, Electrical stability, *Electric generators, Electric potential, Direct currents, Alternating currents, Losses.
Identifiers: Leakage current, *Rotating machines, *Electrical design, Foreign research, Belgium, Flux density, Harmonics, Machine design.

Several aspects of exciter design using semiconductor rectifiers are analyzed. Machine design and methods for reducing differential leakage and stray load losses in windings are discussed. This analysis is conducive to the study of the classical star-connected 3-phase windings and polygonally connected windings with a higher number of phases. A comparison of different possibilities is made using tables, curves, and winding arrangements. The definition of exciter speed of response has been adapted to take into account the influence of armature reaction; this variation has been examined as a function of the number of poles and of various design parameters. Time constants for rotating rectifier exciters are similar to those for d-c exciters

of the same speed, and considerably lower than those for exciters used on large a-c generators. Manufacturers have several methods at their disposal to overcome problems of differential leakage, supplementary losses, and attendant voltage drops. (USBR)
W69-00575

IMPORTANCE OF FRETTING IN VIBRATION FAILURES OF STRANDED CONDUCTORS,
Alcoa Research Laboratories, New Kensington, Pa and Massena, N Y.
William G. Fricke, and Charles B. Rawlins.
Inst Elec Electron Eng Trans Power App Syst, Vol PAS-87, No 6, pp 1381-1384, June 1968. 4 p, 6 fig, 8 ref.

Descriptors: *Fatigue (Mechanics), *Failure (Mechanics), *Vibrations, Corrosion, *Transmission lines, Tensile stress, Test procedures, Oxides, Test specimens, Laboratory tests, Spectroscopy, Coatings, Films, Cracks, Investigations, Aluminum alloys, Abrasion, Friction.
Identifiers: *Fretting, *Electric conductors, Aeolian vibration.

Surface fretting between conductor strands and support hardware plays an important part in conductor fatigue failures initiated by aeolian vibration. Examination of conductor strand failures from lines in service and from laboratory spans shows that fatigue cracks originate at fret marks in all cases. Laboratory fatigue tests indicate that fretting causes a reduction in fatigue strength of conductor strands, below that of unfretted wires, by a factor of 1.6. Test procedures are explained and results of metallographic examination of 23 laboratory fatigue test specimens and 7 in-service failures are discussed. Fretting effects can be reduced by applying surface coatings, but their permanence remains undetermined. (USBR)
W69-00579

CONSIDERATIONS IN PLANNING FOR RELIABLE ELECTRIC SERVICE,
General Electric Co, Schenectady, N Y.
Charles Concordia.
Inst Elec Electron Eng Sprectrum, Vol 5, No 8, pp 71-76, Aug 1968. 6 p, 3 fig, 5 ref.

Descriptors: Electric power, *Reliability, Design, Planning, *Electric power production, *Transmission (Electrical), Disturbances, Frequency, *Power system operations, Electric relays, Faults (Electrical), Loads.
Identifiers: *Load shedding, *Load-frequency control, Interconnected systems, Tie lines, Outages, Operating criteria, Load flow.

Satisfactory levels of reliability of bulk-power generation transmission systems depend on sound principles of planning, design, and operation, rather than revolutionary changes. To assure this reliability, it requires effective transmission and adequate interconnections, adherence to operating limitations, and recognition that an unforeseen contingency will cause system separation and generator deficiency. The first consideration requires system studies to demonstrate that no single disturbance will cause cascading tripouts of lines or generators; the second may be facilitated by automatic monitoring of the system condition; and the third requires automatic load shedding on low frequency. Designing and operating principles required for satisfactory service reliability are summarized. The stages of system planning for determining proper system design and required transmission and generation capacity are outlined. System operating limits and system splitup are discussed. (USBR)
W69-00598

MAJOR HYDROELECTRIC POWER PLANTS IN TEXAS: HISTORICAL AND DESCRIPTIVE INFORMATION,
Texas Water Development Board, Austin, Texas.
F. A. Godfrey, and C. L. Dowell.
Tex Water Develop Board Rep 81, 93 p, Aug 1968. 28 fig, 22 tab, 10 ref.

Descriptors: *Data collections, *Hydroelectric plants, *Texas, Dams, Electric power production, Engineering structures, Water rights, Water utilization.
Identifiers: *Electrical energy generation.

Descriptions of the 25 major hydroelectric powerplants in Texas are given chronologically to show their historical development to Jan 1, 1968. Records of electrical energy generated at each plant follows the plant description. Included are descriptions of 4 plants which are no longer in operation. Information on the water rights applicable to each powerplant is presented. Photographs of some of the plants are included. No description is given of the many small hydroelectric plants used by early settlers to operate grain mills, cotton gins, saw mills, water pumps, and other equipment. These are described in 'The Water Power of Texas' (Taylor, T W, 1904). (Lang-USGS)
W69-00692

8D. Soil Mechanics

DADE COUNTY, FLORIDA (BEACH EROSION CONTROL AND HURRICANE PROTECTION).
Army Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-00441

NONLINEAR FLOW THROUGH GRANULAR MEDIA,
Imperial College of Science and Technology, London, Great Britain.
David Ellis Wright.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY4, pp 851-872, July 1968. 22 p, 9 fig, 1 tab, 23 ref, 3 append.

Descriptors: *Granular materials, *Flow, *Fluid flow, Anemometers, Hot wire anemometers, Reynolds number, Flud friction, Unsteady flow, Steady flow, Velocity, Turbulence, Laboratory equipment, Laboratory tests, Air, Gravels, Sands, Permeameters, Boundary layer, Hydraulics, Bibliographies.
Identifiers: Foreign research, Great Britain, Resistance coefficients, Darcys law.

Relative roles of steady and unsteady fluid motion in causing deviation from the linear Darcy resistance law are described. Air velocities and turbulence intensities were measured within the pores of a gravel bed by hot-wire anemometers. Results indicate that although the linear resistance relation ceases to be valid at a Reynolds number of 2, velocity fluctuations do not begin until the Reynolds number is 100, and turbulence is not fully established until the Reynolds number is 800. Studies of waterflow through a coarse sand bed show that convergence of the macrostreamlines significantly reduces the resistance at Reynolds numbers over 10, the proportionate reduction increasing with flow. Observations are interpreted in terms of flow through coiled pipes or around immersed objects; 4 regimes of flow through granular media are proposed. (USBR)
W69-00577

FLOW AROUND A VERTICAL SHEETPILE EMBEDDED IN AN INCLINED STRATIFIED MEDIUM,
Northwestern Univ, Evanston, Ill.
Raymond J. Krizek, and Vera B. Anand.
Water Resour Res, Vol 4, No 1, pp 113-123, Feb 1968. 11 p, 7 fig, 23 ref, append.

Descriptors: *Flow, *Fluid flow, *Sheet piling, Stratification, Porous materials, *Permeability, Anisotropy, *Seepage, Bibliographies, Models, Laboratory equipment, Laboratory tests, Hydraulic models, *Groundwater flow, Sandstone, Flow nets.
Identifiers: *Flow around objects.

The steady-state flow around a vertical sheetpile embedded in an inclined stratified porous medium underlain by an impervious boundary is studied experimentally. The porous medium is a synthetic sandstone composed of alternating thin layers of 2 sand-epoxy mixtures with different coefficients of permeability. The problem is subjected to a coordinate transformation by considering the layered system as homogeneous and anisotropic; a graphical flow net solution is obtained for the streamlines, potential distribution, and flow quantity. The complex variable theory and conformal mapping techniques are used to obtain an approximation for flow quantity and exit gradient variation. Experimental results on streamlines, potential distribution, flow quantity, and exit gradient were obtained from a model study, and exhibited variations from predicted theoretical results, especially in flow quantities. A systematic study of experimental errors suggests that these variations cannot be attributed wholly to experimental sources and implies that the effective permeability of a stratified porous medium cannot be determined by considering the system as homogeneous and anisotropic. (USBR)
W69-00584

SOIL DYNAMICS,
Auckland Univ, New Zealand.
P. W. Taylor.
N S Eng, Vol 23, No 6, pp 225-229, June 1968. 5 p, 4 fig, 22 ref.

Descriptors: *Loading time, Loads, Loading rate, *Live loads, Seismic waves, Earthquakes, Soil tests, Soil stability, Microstructures, Soil physical properties, Soil structure, Oscillation, Rheology, Sands, Soil mechanics, Liquefaction, Cohesive soils, Granular materials, *Dynamics, Moisture content, Clays, Bibliographies, *Soils.
Identifiers: *Soil dynamics, Earthquake loads, Dynamic response, Dynamic tests, Dynamic loads.

Soil dynamics is concerned with rapidly varying stresses in a soil mass. The relationship between soil dynamics and applied sciences of rheology, geophysics, and seismology is discussed. Three types of time-dependent stress conditions are considered in soil dynamics: (1) transient--a single pulse that reaches a maximum quickly and may cause failure; (2) repeated--may not cause failure immediately but may alter soil properties and cause failure eventually; and (3) oscillatory--varies roughly sinusoidally with time. Transient loading tests on clays show that strength and modulus of deformation increase with rate of strain. Rate of strain has little effect on properties of granular materials under transient loading. Repeated loading of some clays increases the ultimate strength as much as 3 times its original value. Oscillatory loading may result from artificial (machine vibrations) and natural (earthquakes) sources. Granular materials having the proper degree of saturation and density may liquefy and lose shearing resistance when subjected to oscillatory loading. Tests show that cohesive soils may fail after several cycles at a stress much below short-duration transient or static values. (USBR)
W69-00586

SELECTION OF ANALYTICAL METHODS AND STRENGTH PARAMETERS FOR SLOPE STABILITY INVESTIGATIONS IN COHESIVE SOILS,
Idaho Univ, Moscow.
Robert L. Schuster.
Highway Res Rec, No 223, 1968. 8 p, 4 fig, 4 tab, 18 ref.

Descriptors: Slopes, *Stability analysis, *Cohesive soils, Cohesion, Clays, Shear strength, Embankments, Pore pressures, Cut slopes, Internal friction, Failure (Mechanics), Consolidation, Overconsolidation, Strain, Shear tests, Effective stress, Total stress, Fissures, Bibliographies, Soil mechanics, Cuts.
Identifiers: Failures, Failure surfaces, Strain rate, Soil properties, *Slope stability, Slip surface, Bishops method, Slip-circle method.

Case histories of slope failures in clays are reviewed to aid in selecting the proper shear strength parameters and methods of stability analysis. The phi equals zero total stress method is satisfactory for short-term stability analysis of nonfissured clays. The phi equals zero analysis is not safe for short-term stability of fissured, overconsolidated clays unless the reduced strength due to the presence of fissures is considered. When working with overconsolidated clays, the rate at which the undrained shear test is conducted has considerable effect on the laboratory undrained shear strength, and the undrained shear strengths obtained in the common 15-minute test may be higher than those in the slope at failure. Analysis on an effective stress basis is preferable to the phi equals zero total stress analysis for long-term stability of slopes in nonfissured clays. Bishops method results in better analyses than the conventional method of slices that produces factors of safety for the failure state that are 15-20% too conservative. Effective stress methods of analysis should be used for long-term stability of slopes in overconsolidated clays containing fissures or other discontinuities. (USBR)
W69-00590

LABORATORY INVESTIGATION ON THE USE OF HIGH MOISTURE CONTENT SOILS IN HIGH FILLS,
Kentucky Univ, Lexington; Virginia Highway Research Council.
Y. H. Huang, and F. D. Shepard.
Highway Res Rec, No 223, pp 45-59, 1968. 15 p, 7 fig, 3 tab, 11 ref.

Descriptors: *Moisture content, *Embankments, Soils, *Shear strength, Consolidation, Direct shear, Thixotropy, Silts, Loams, Test procedures, Compaction, Saturation, Shear tests, Soil physical properties, Density, Cost comparisons, Void ratios, Soil mechanics, Pore pressures, *Fills, Test specimens, Compaction tests.
Identifiers: Soil density, Test results.

Dunmore silt loam and Clarkesville clay loam were used to investigate the effects of high moisture-content soils in high fills. Soil specimens were fabricated by static compaction and investigated by direct shear and conventional consolidation tests. The soil did not exhibit thixotropic behavior under given test conditions. Shear strength increased with consolidation pressure, the rate of increase being greater at lower densities. Initial density had the greatest effect on shear strength when soils were not subjected to consolidation. Regardless of initial density and strength, soils subjected to high consolidation pressures would arrive at some density and strength that were only slightly different. Based on the assumption that density is the most important factor affecting strength and on Terzaghi's theory of consolidation, a procedure is suggested to determine the depth below which wet soils would be placed and the length of drainage path required to effect a given degree of consolidation. A cost analysis must be conducted before any decisions on using high moisture-content soils are made. Handling wet material and installing drainage may be more expensive than importing borrow material. (USBR)
W69-00599

CALCULATION OF DEEP SUPPORTS IN TERMS OF DEFORMATIONS,
Kh R. Khakimov.
Soil Mech Found Eng, No 6, pp 402-406, Nov-Dec 1967. 5 p, 3 fig, 1 tab, 4 ref. Transl from Russ, Osn, Fundamenty i Mekh Gruntov, No 6, pp 14-17, Nov-Dec 1967.

Descriptors: *Foundations, Cast-in-place structures, Piles, Analysis, Pile foundations, *Supports, Elastic deformation, Plastic deformation, Strain, Stress-strain curves, Settlement, Shear failures, Consolidation, Shear strength, Footings, Soil physical properties, Poisson ratio, Soil mechanics.
Identifiers: Foundation modulus, Deep footings, Foreign research, USSR, Deformation modulus.

The design of deep foundations can be expedited by using deformations involving the linear relation between stress and strain. However, designs considering the nonlinear relation of stress and strain are needed for better use of soil resistance and to lower foundation costs. Separate determination of settlements caused by soil consolidation and by development of a shear zone is proposed. In 1 case the settlement resulting from consolidation was 19.9 cm and 1.1 cm from shear, or 6%. Simplified calculations of deformation for deep supports (large cast-in-place piles) require consideration of 2 factors: (1) The relation between stress and strain is nonlinear, causing the modulus of soil deformability to be variable. (2) Strain is composed of permanent set and elastic strain, the first being greater. Equations are presented for the deformability modulus, limits of proportionality, nonlinear deformability of soil, and strain. A table lists 11 sets of tests on different soils. The analysis accommodates soil resistance beyond the limits of linear stress-strain relation and permits increasing the load on the supporting soil by a factor of 1.4 to 2. (USBR)
W69-00609

A REVIEW OF RECENT RESEARCH ON STRENGTH AND CONSOLIDATION OF SOFT SENSITIVE CLAYS,
University of Toronto, Canada.
T. Cameron Kenney.
Can Geotech J, Vol 5, No 2, pp 97-119, May 1968. 23 p, 12 fig, 3 tab, 43 ref.

Descriptors: *Shear strength, Shear forces, *Shear resistance, Failure (Mechanics), Shear stress, *Clays, *Consolidation, Deformation, Internal friction, Cohesion, Sampling, Clay minerals, Boundaries, Triaxial shear, Shear tests, Undisturbed samples, Laboratory tests, Shear strain, Direct shear, Soil mechanics, Preconsolidation, Bibliographies.
Identifiers: *Compressibility, Strain energy, At rest pressure, Bond, Secondary consolidation, Foreign research, Canada.

New concepts have been developed of strength and consolidation of soft sensitive clays. Shear strength and compressibility are measures of a soil's resistance to deformation but for different boundary conditions. These soil behaviors depend on shear resistance that can be developed at contacts between individual mineral particles. The coefficient of friction depends on mineralogy of the particles and degree to which particles are parallel oriented. Shear resistance of parallel-oriented, plate-shaped, clay minerals can be more than 30% less than for randomly oriented particles. Cohesion is caused by net attractive forces between adjacent particles (Van der Waal forces) and interparticle linkages formed by polarized ions. Undisturbed soft sensitive clay samples are impossible to obtain because stress changes that accompany sampling cause irrecoverable strains in the clay. Soft clays do not behave elastically when restressed to their in situ stresses; in situ behavior cannot be reproduced in the laboratory simply by reapplication of stress. Situations and reasons are given for the preconsolidation pressure being greater than the greatest overburden ever experienced by a soil. (USBR)
W69-00615

DESIGN AND CONSTRUCTION OF A HORIZONTAL VISCOUS FLOW MODEL,
Delaware Univ., Newark.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00628

SEEPAGE FLOW THROUGH AN EARTH DAM,
Georgia Inst. of Tech., Atlanta, Civil Engineering Sch.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00665

8E. Rock Mechanics AND Geology

STATIC LOADING ON THE SURFACE OF LAYERED MEDIA,
Columbia Univ, New York, N Y.
J. T. Kuo, G. Barla, and S. H. Boshkov.
Pap, Preprint No 68-AM-101, Annu Meet Amer Inst Mining, Met, Petrol Eng, New York, Feb 1968. 45 p, 10 fig, 1 tab, 7 ref.

Descriptors: Loads, Statics, *Underground structures, *Rock mechanics, Mining engineering, Mathematical analysis, Matrix algebra, Model tests, Stress, Structural models, *Stress analysis, Elasticity, Displacements, Structural analysis.
Identifiers: Boussinesq equation, Static behavior, Underground openings.

The Boussinesq solution to the problem of a normal static load on the surface of a half-space has wide application to loading problems in engineering. The generalized solution of an inclined static load on the surface of a multilayered half-space is applied to a system of randomly distributed inclined loads, simulating conditions of circular pillar loading in a mine. Inclined loads are assumed to be a linear combination of a normal load and an asymmetrical shear load. Such loads may arise from applied displacements, applied stresses, or combinations of both. Each layer is considered homogeneous and isotropic; layer interfaces are assumed perfectly welded. The problem is solved using the Thompson-Haskell matrix formulation which avoids the cumbersome nature of the problem and is easily adaptable to numerical evaluation. Stresses from a normal static load are calculated and compared with geletin model tests, simulating mining conditions of pillar loading on continuous horizontal-layered media. (USBR)
W69-00603

CRUSHED LIMESTONE BARRIERS: A BASIC FEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00637

8F. Concrete

LARGE DIAMETER NONREINFORCED CAST-IN-PLACE CONCRETE PIPE,
Ernest C. Fortier.
J Amer Concr Inst, No 7, Proc V 65, pp 544-549, July 1968. 6 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Concrete pipes, Concrete placing, *Pipes, Construction, Pipelines, *Cast-in-place structures, Concrete, Irrigation, Structural analysis, Sewers, Costs, Construction costs, Cost comparisons, Trenches, Forms (Concrete), Field tests, Shoring, Excavation.
Identifiers: Sacramento Valley, Calif, Formwork (Construction), *Cast-in-place pipes, Construction equipment, Concrete properties.

Recent installations of large-diameter (60, 72, 84, and 96 in.) nonreinforced cast-in-place pipe have shown satisfactory performance. Continuous casting machines can be constructed for large pipe as easily as for small pipe if proper design and mechanization are used. Sacramento County, Calif, one of the early users of large pipe, made its first installation in 1955. Th County found that the principal advantage of cast-in-place pipe was to be found in 30 to 40% cost savings over conventional pipe. The continuous casting process developed by No-Joint Concrete Pipe Co is described. A separate slipform is required for each pipe size. Aluminum part-circle forms are used to support 230 deg of the inside of the pipe. In many respects large sizes facilitate rather than hinder construction of

monolithic pipe by the continuous casting process. Compressive strength of concrete is specified as 3000 psi. Excavation is accomplished with back hoes or ladder-type excavators. Hardpan soils offer ideal conditions for monolithic pipe, but expansive soils must be expanded fully before concrete placement. Strength tests show that pipes up to 120 in. could be made to safely support earth and live loads normally encountered in irrigation systems, storm drains, and sanitary sewers. (USBR)
W69-00581

GUIDE FOR LOW DENSITY PRECAST CONCRETE FLOOR, ROOF, AND WALL UNITS,
Albert Litvin, L. E. Rivkind, and Leslie A. Barron.

J Amer Concr Inst, No 7, Proc V 65, pp 507-512, July 1968. 6 p, 1 tab, 17 ref.

Descriptors: *Lightweight aggregates, *Precast concrete, Deflection, Concrete testing, Slabs, Concrete technology, Prefabrication, Concrete, Perlite, Roofs, Walls, Structural design, Design data, Bibliographies, Thermal conductivity, Vermiculite, Shrinkage, Elasticity modulus, Curing, Acceptance tests, Floors.
Identifiers: *Lightweight concretes, Fire resistance.

Design and fabrication practices are outlined for low-density (50 pcf and under), precast, reinforced-concrete floor, roof, and wall units that will result in members of adequate load capacity, durability, appearance, and overall serviceability. Units covered in this guide should be protected from free entry of water. Current editions of applicable ASTM specifications are listed for the materials covered in the guide. Low-density concrete should have a minimum compressive strength of 300 psi, and average drying shrinkage should not exceed 0.20%. Low-density concrete units should be designed for allowable working stresses, service loads, and accepted straight line theory of design. Deviations from design requirements and treatment of regular concrete are discussed. (USBR)
W69-00583

CONCRETE WITH REINFORCED PLASTICS COATING,
Technical Univ, Prague, Czechoslovakia.
Vladimir Weiss.
Tech Dig, Vol 10, No 6, pp 369-374, June 1968. 6 p, 5 fig, 2 tab, 7 ref.

Descriptors: *Composite materials, *Laminates, *Sandwiching, Plastics, Reinforcing, *Reinforced concrete, Materials, Materials forming, Foreign design practices, *Coatings, Brittleness, Tensile strength, Cracking, Bending stress, Glass fibers, Ceramic materials, Concrete structures, Concrete.
Identifiers: Czechoslovakia, Polyesters, Glass reinforced plastics, *Plastic coatings, Composite beams.

The possibility of replacing steel reinforcement in concrete with reinforced plastics or glass fiber has kept researchers busy for many years. Work in Czechoslovakia has been concentrated on coating concrete and similar brittle materials with glass-fiber-reinforced polyester resin. The coating delays formulation of cracks and improves extensibility and bending strength of concrete and ceramic products. Tests were conducted to clarify the load-sharing mechanism and properties of coating and core materials affecting test results. The effect of the coating on extensibility, tensile strength, and bending strength of brittle materials has been so pronounced that prestressed concrete often may be replaced by ordinary reinforced concrete. A procedure is given for designing combinations of brittle core materials with resilient coatings. The method is applicable to combinations of concrete or ceramics with prestressed concrete, resin concrete, or sheet metal; asbestos-cement with fiber-reinforced plastics; and sandwich materials of lightweight concrete, hard-formed materials, and asbestos-cement materials. (USBR)
W69-00593

FIELD TECHNIQUES FOR SEALING LEAKY CONCRETE PIPELINES WITH AMMONIATED IRRIGATION WATERS, OPEN AND CLOSED CONDUIT SYSTEMS RESEARCH PROGRAM,
California Univ, Davis; Solano Irrigation District, Vacaville, Calif.
K. K. Tanji, L. D. Doneen, and J. V. Kubes.
Bur Reclam Lab Rep ChE-79, Chem Eng Br, May 1968. 54 p, 2 map, 11 tab, 20 photo, 7 ref.

Descriptors: *Concrete pipes, *Cracks, Chemistry, Water analysis, pH, Conduits, Pipelines, *Leakage, Water transportation, Seepage, Additives, Chemicals, *Sealing compounds, Maintenance, Operation and maintenance, *Lime, *Chemical precipitation, Irrigation O and M.
Identifiers: *Calcium carbonate, Irrigation water, *Anhydrous ammonia, Chemical reactions, *Chemical sealants, Solano Project, Calif.

A method is described for sealing narrow cracks in concrete pipelines. Anhydrous ammonia and other amendments added to water produce a hard calcium carbonate precipitate which deposits in cracks in the pipe and seals the leaks. Laboratory investigations were made on the chemistry of surface and ground waters suitable for lime precipitation. Selective precipitation of lime from ammoniated waters and its adherence to concrete pipelines are largely dependent upon the chemical composition and imposed treatments. Many irrigation waters are not suitable for precipitating lime unless treated with appropriate amendments. Theory and principles from the laboratory research were applied in field tests. Methods and techniques were developed for sealing leaky concrete pipelines. The field application and results obtained in some treatment operations with surface and well waters are presented. (USBR)
W69-00610

CRITERIA FOR CATHODIC PROTECTION OF STEEL IN CONCRETE,
American Pipe and Construction Co, South Gate, Calif.
D. A. Hausmann.
Preprint Pap No 74, Nat Ass Corros Eng, Cleveland, Ohio, 1968. 4 p, 5 fig, 7 ref.

Descriptors: *Cathodic protection, Corrosion, *Corrosion control, Concrete structures, Portland cement, Chlorides, Electrolysis, Steel, Electrochemistry, *Reinforced concrete, *Reinforcing steel, Electrodes, Electric potential, Design criteria, Electric currents, Polarization.
Identifiers: Corrosion tests, Corrosion resistance, Stray current corrosion, Corrosion currents.

Cathodic protection is a useful corrosion control technique, but indiscriminate use can be costly and damaging. Misapplication is possible with reinforced concrete structures if the passivating effect of portland cement is not recognized. Some reinforced concrete structures are cathodically protected, as if they were bare or coated steel structures, by using the buried steel pipeline criterion of applying current to maintain a minimum steel potential of -0.85 v to a copper sulfate electrode. Experimental results show that this criterion is not applicable to steel cast in concrete and will result in overportection. Steel corrosion can be prevented in concrete exposed to a high chloride environment if sufficient current is applied to shift the steel polarization potential to a minimum value of -0.50 v to a copper sulfate electrode. Steel corrosion can be arrested in chloride-contaminated concrete by shifting the polarization potential to a minimum value of -0.71 v to a copper sulfate electrode. The polarization potential should be shifted to a minimum of -0.40 v to a copper sulfate electrode to prevent damage by stray current electrolysis. (USBR)
W69-00611

ARCHITECTURAL CONCRETE,
Architectural Concrete Consultants Inc, Houston, Tex; Hellmuth, Obata and Kassabaum, St Louis, Mo.
James M. Shilstone, Gyo Obata, and Matthys P. Levy.
J Amer Concr Inst, No 7, Proc V 65, pp 513-534, July 1968. 22 p, 26 fig, 3 tab.

Descriptors: *Architecture, *Concrete, Concrete finishing, Coatings, Precast concrete, Building materials, Buildings, Shell structures, Forms (Concrete), Finishes, Concrete placing, Joints, Curing, Specifications, Reinforced concrete, Shrinkage, Costs, Aggregates, Creep, Structural engineering, Abrasive blasting, *Aesthetics, Construction, Planning.
Identifiers: Exposed aggregate concrete, Concrete construction, Concrete properties.

This series of papers is based on a symposium presented at the 1966 ACI Fall Meeting in New Orleans. The papers review considerations required for architectural concrete that must be structurally sound, aesthetically pleasing, and economical. Following a brief introduction, 4 authors discuss the architects' approach, structural implications, planning requirements, and construction. When an architect selects concrete as the aesthetically correct material, he must check the structural appropriateness. In addition to obvious design considerations, the structural designer must give special attention to detailing placement of joints, placement of reinforcement, and curing methods to obtain the desired effects. Advance detailed planning is important when using architectural concrete because lines that appear effective on drawings can be difficult and costly to achieve in construction. Building with architectural concrete requires detailed consideration of materials, forming techniques, concreting operations, and surface finishing. (USBR)
W69-00614

8G. Materials

POLYMER COATINGS PIGMENT DISPERSION,
PPG Industries, Pittsburgh, Pa.
V. Buttignol, and Howard L. Gerhart.
Ind Eng Chem, Vol 60, No 8, pp 68-79, Aug 1968. 12 p, 12 fig, 3 tab, 42 ref.

Descriptors: Reviews, *Paints, Coatings, Flocculation, Bibliographies, *Protective coatings, Painting, *Polymers, *Pigments, Vehicles, Physical chemistry, *Dispersion, Mixing, Adsorption, Light, Scattering, Solvents, Surface properties, Materials.
Identifiers: *Wetting, Separation, Double layer, Resins.

The technology of pigment dispersion in polymer paint manufacturing is reviewed. The dispersion process is complicated, incompletely understood, and in practice is regularly and consciously neglected as to its scientific delicacy. Our present imperfect understanding starts with uncertainty about the pigment surface structure and is complicated by the great variety of phenomena as the liquid polymer finds its place upon the solid particle. Absorption mechanisms and theories of dispersion are reviewed to improve understanding of the complex process. The 3 basic stages in the dispersion process are wetting, deagglomeration or physical separation of particles by force, and stabilization. The dispersion of pigment as it exists in the cured paint film is very important as a fourth stage but has been neglected. A suggestion is made that a more profitable approach would be to study the end result (dispersion in the cured film) and work backward to find the optimum conditions at the earlier stages. This approach was adopted by the Springdale Research Center and resulted in developing a paint utilizing a new light scattering concept with extraordinary efficiency. (USBR)
W69-00578

CONCRETE WITH REINFORCED PLASTICS COATING,
Technical Univ, Prague, Czechoslovakia.
For primary bibliographic entry see Field 08F.
For abstract, see .

W69-00593

8H. Rapid Excavation

GEOPHYSICAL LOGGING AND HYDRAULIC TESTING, PAHUTE MESA, NEVADA TEST SITE,
U S Geological Survey, Las Vegas, Nevada.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00434

CANAL CONSTRUCTION USING ROW CHARGES IN THE EXPLOSIVE EXCAVATION AT ALLARECHENSK MINE,
Soiuzvzryvprom, USSR.
F. A. Avdeev.
Vzryvnoe delo, Sb 61/18, pp 161-175, Moscow, 1966. Transl from Russ, Bur Reclam Transl 773, June 1968. 37 p, 11 fig, 7 tab, append, 2 ref.

Descriptors: *Canals, Explosions, *Explosives, *Excavation, Foreign projects, Charges (Explosives), Soil mechanics, Methodology, *Cratering, Soil liquefaction, Soil structure, Drainage, Moraines, Sand boils, Soil physical properties, Sands, Soil moisture, Pore water pressures.
Identifiers: USSR, Depth, Allarechensk Canal, USSR, Depth of burst, *Explosive excavation, Unstable ground, Spacing, Spaced charges.

A special bureau of explosive experts in the USSR used row-charge explosive excavation to build the Allarechensk drainage canal to drain a mining area in Kirgistan. Design data were: length 4.7 km, width at bottom 5.5 m, bottom slope 0.0015, side slopes 2.5:1, depth 3 to 10 m, and average discharge 27 to 34 cu m/sec. Most of the canal runs through morainic stable soils, but unstable liquefying soils were encountered in one reach. Conclusions were that: (1) the method is feasible for hydraulic structures located away from industrial areas, saving construction time and requiring less equipment; (2) in morainic soils with 30 to 35% boulders, the method excavates a design profile with stable side slopes; (3) in yielding soils, the method enables reductions in labor and time, but more explosives must be used to compensate for inability to place charges at optimum depth; (4) the method can be used in unstable liquefying soils by double explosion, the first to destroy the soil structure and the second to excavate the structure after draining; (5) using war surplus explosives is feasible; and (6) further investigations of explosions for liquefying soils are needed. (USBR)
W69-00613

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

A COMPILATION OF WATER RESOURCES RESEARCH AND GRADUATE TRAINING ACTIVITIES AT NEW MEXICO STATE UNIVERSITY,
New Mexico State Univ., University Park.
John W. Hernandez.
New Mexico State Univ, WRRI Publications No 1, 1966. 72 p. OWRR Project A-999-NMex.

Descriptors: Water resources, *Water resources development, Hydrology, Ecology, Research and development, Economics, Hydraulics, Agriculture, Fluid mechanics, Irrigation, Limnology, Water treatment, Water quality, Education.
Identifiers: *Research project notices.

This publication is a summary of active research studies and supported graduate training programs in the water-resource field at New Mexico State University as of July 1, 1966. Training programs receiving outside grants are included in the text as they provide a significant source of funding for graduate students. The current research projects included in the compilation have been classified into subject matter groups shown in the Table of Contents. An index listing authors, research topics, and funding agencies is included. This compilation reflects the magnitude, interest and diversity of water resources research being conducted throughout the University. It will be noted that a number of the studies listed are not funded by the University nor by any outside agency. In general, projects of this nature are in a preliminary development stage or are unsupported student thesis topics. Funded projects are administered through one or more of the following organizations: (1) the Water Resources Research Institute, (2) the Agricultural Experiment Station, (3) the Engineering Experiment Station, and (4) the Research Center.
W69-00648

9C. Research Facilities

BRIDGER HYDROMETEOROLOGICAL RESEARCH AREA AND FACILITIES,
Montana State Univ., Bozeman, Water Resour. Res. Center.
R. J. Rickabaugh.
Rep 4 of Proj 779 (See W69-00452 and W69-00454), Jan 1967. 26 p, 47 fig, 1 tab. OWRR Proj B-006-Mont.

Descriptors: *Research facilities, *On-site laboratories, On-site data collections, Data collections, Field data, Meteorology, Montana, *Meteorological data, Weather data, Communication, Electronic equipment, Instrumentation, Evaluation, Radio communication systems, Telephones.

The Bridger Hydrometeorological research area and facilities 20 mi north of Bozeman, Montana are described. Numerous photographs, illustrations and maps are used to present the research facility and site locations.
W69-00453

9D. Grants, Contracts, AND Research Act Allotments

INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA,
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
David H. Howells.
Rep 4, Apr 1967. 80 p. OWRR Proj A-999-NC.

Descriptors: Census, *Water resources, *Research and development, *North Carolina, Water resources development.

This inventory of water resources research projects in North Carolina is one of three basic reports prepared by the Water Resources Research Institute to guide the development of its research program. Earlier reports included 'Water Resources Problems and Research Needs of North Carolina' and 'Water Resources Research Interests in the Senior Colleges and Universities of North Carolina.' The report lists all known research projects in North Carolina, including private industry and the State and Federal Agencies. It will be revised annually.
W69-00458

CURRENT WATER-RELATED STUDIES IN THE STATE OF MAINE,
Maine Univ., Orono, Water Resources Center.
Warren Viessman, Jr.
Water Resour Center Publ 3, Univ Maine, Apr 1968. 68 p. OWRR Project A-999-Me.

Descriptors: *Bibliographies, *Maine, *Abstracts, *Water resources, Ecology, Biology, Erosion; Soil erosion, Geochemistry, Hydrology, Irrigation, Marshes, Recreation, Soils, Water treatment, Water quality, Waste treatment, Meteorology, Weather, Climatology.

This document lists 93 water-related investigations underway in Maine. Information gives name of project, principal investigator, source of funds, name and address of agency, and abstract of work.
W69-00657

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